SEAMAP-SA
ANNUAL REPORT

RESULTS OF TRAWLING EFFORTS IN THE COASTAL HABITAT OF THE SOUTH ATLANTIC BIGHT, FY - 1999

Prepared By

SEAMAP - SA / SCMRD Staff[1]

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Southeast Area Monitoring and Assessment Program - South Atlantic (SEAMAP-SA) of the National Marine Fisheries Service (NMFS) and the South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD) has conducted a shallow water trawl survey in the coastal zone of the South Atlantic Bight since 1986. This survey provides long-term, fishery-independent data on seasonal abundance and biomass of finfish, elasmobranchs, decapod and stomatopod crustaceans, and cephalopods that are accessible by high-rise trawls. Twenty-three finfish and four decapod species (Appendix 1) were selected as priority species by the SEAMAP-SA Shallow Water Trawl Committee. Data recorded for target species of fishes and decapod crustaceans include measurements of length or width for all priority species and reproductive information on commercially important penaeid shrimp and blue crabs.

Field data collected by the SEAMAP-SA Shallow Water Trawl Survey is available to users within a few weeks of collection. SEAMAP-SA trawl data collected from 1986 to the present are now available through the SEAMAP-SA Data Management Office at NMFS[2]. Management agencies and scientists currently have access to ten years (1990-1999) of comparable trawl data from near-shore coastal areas of the South Atlantic Bight.

This report summarizes information on species composition, abundance, and biomass, as well as seasonal and regional trends in temperature and salinity from the 1999 survey. Length-frequency distributions of eight commercially and ecologically important species, along with reproductive attributes of the commercially important penaeid species, are presented. Brief summaries are also included for three numerically dominant shark species.

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[2]Data are available through the SEAMAP Data Manager (NMFS, Building 1103, Room 218, Stennis Space Center, MS 39529).

METHODS AND MATERIALS

Data Collection

Samples were taken by trawl in 1999 from the coastal zone of the South Atlantic Bight (SAB) between Cape Hatteras, North Carolina, and Cape Canaveral, Florida (Figure 1). Multi-legged cruises were conducted in spring (April 12 - May 13), summer (July 12 - July 30), and fall (October 4 - November 8). Stations were randomly selected from a pool of trawlable stations within each stratum. The number of selected stations in each stratum was proportionally allocated according to the total surface area of the stratum. A total of 78 inner stations was sampled each season within twenty-four inner strata, delineated by the 4 m depth contour inshore and the 10 m depth contour offshore. The mean area sampled during a standard tow in 1999 was estimated to be 3.788 ha for stations in inner strata.

Portions of the 1999 sampling effort were directed toward deeper strata with station depths ranging from 10 to 19 m. Twenty-seven stations located within ten outer strata in the southern half of the SAB were sampled in spring to collect data on spawning of white shrimp. Sixteen additional stations in the seven outer strata off North Carolina were sampled in fall to gather data on the reproductive condition of brown shrimp. No stations in the outer strata were sampled in summer. The mean area sampled was estimated to be 3.867 ha per tow in outer strata.

The R/V *Lady Lisa*, a 75-ft (23-m) wooden-hulled, double-rigged, St. Augustine shrimp trawler owned and operated by the South Carolina Department of Natural Resources (SCDNR), was used to tow paired 22.9-m mongoose-type Falcon trawl nets (manufactured by Beaufort Marine Supply; Beaufort, S.C.) without TED's. The body of the trawl was constructed of #15 twine with 1.875-in (47.6-mm) stretch mesh. The cod end of the net was constructed of #30 twine with 1.625-in (41.3-mm) stretch mesh and was protected by chafing gear of #84 twine with 4-in (10-cm) stretch "scallop" mesh. A 300 ft (91.4-m) three-lead bridle was attached to each of a pair of wooden chain doors which measured 10 ft x 40 in (3.0-m x 1.0-m), and to a tongue centered on the head-rope. The 86-ft (26.3-m) head-rope, excluding the tongue, had one large (60-cm) Norwegian float attached top center of the net between the end of the tongue and the tongue bridle cable and one 9-in (22.3-cm) PVC foam float on either side of the tongue located one-quarter of the distance from each end of the net webbing. A 1-ft chain drop-back was used to

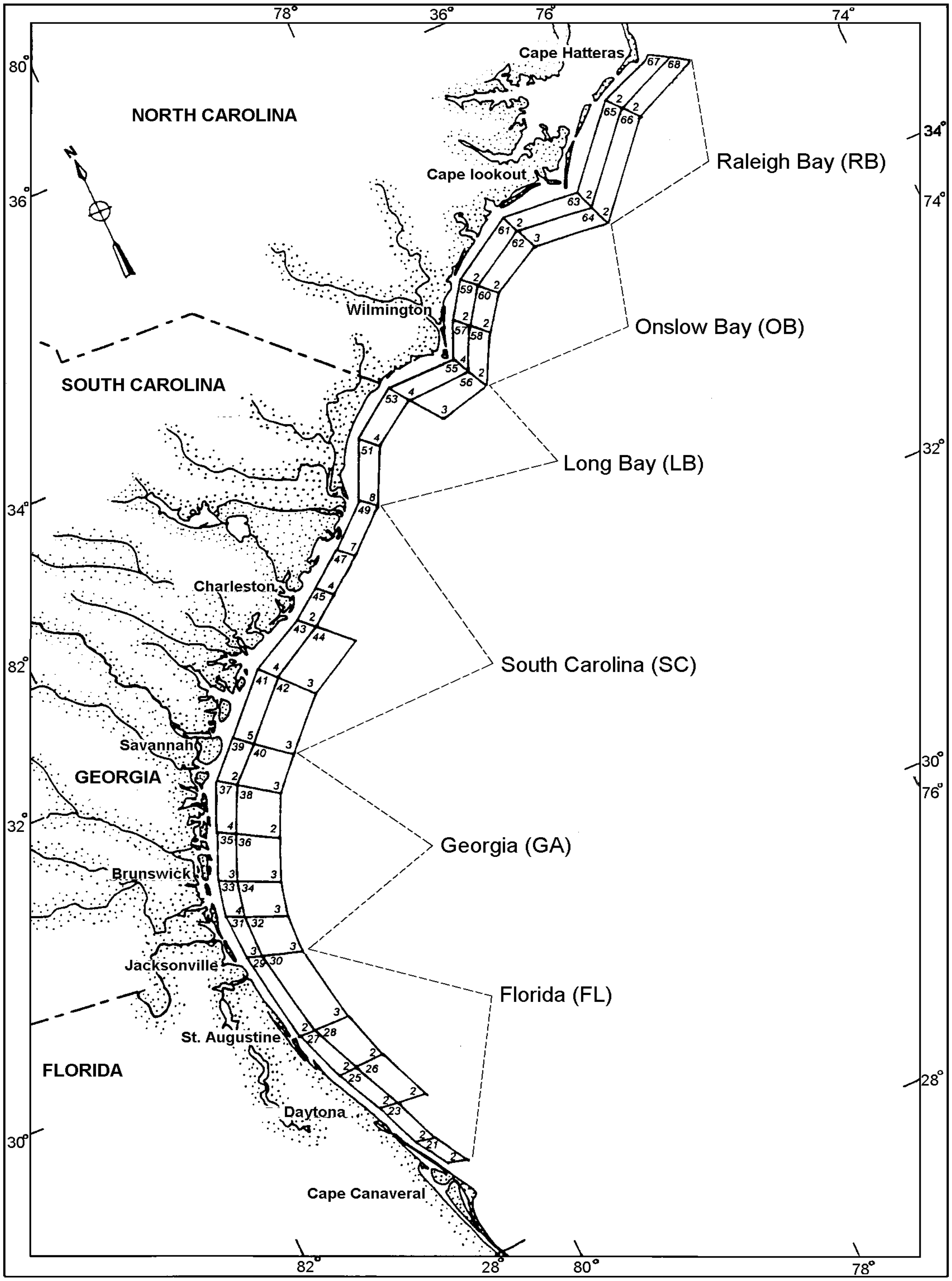

Figure 1. Strata sampled during the 1999 SEAMAP-SA Shallow Water Trawl Survey

attach the 89-ft (27.1-m) footrope to the trawl door. A 0.25-in (0.6-cm) tickler chain, which was 3.0-ft (0.9-m) shorter than the combined length of the footrope and drop-back, was connected to the door alongside the footrope.

Trawls were towed for twenty minutes, excluding wire-out and haul-back time, exclusively during daylight hours (1 hour after sunrise to 1 hour before sunset). Contents of each net were sorted separately to species, and total biomass and number of individuals were recorded for all species of finfish, elasmobranchs, decapod and stomatopod crustaceans, and cephalopods. Only total biomass was recorded for all other miscellaneous invertebrates and algae, which were treated as two separate taxonomic groups. Marine turtles captured incidentally were measured, weighed, tagged, and released according to NMFS permitting guidelines. For trawl catches where visual estimation of weight of total catch per trawl exceeded 500 kg, samples were weighed prior to sorting and a randomly chosen portion of approximately 10% of the total weight was then sorted and processed. For large catches of an individual species, the entire catch of that species was weighed and total number was calculated from a randomly selected subsample which was weighed and enumerated.

Each of the twenty-seven target species was weighed collectively and individuals were measured to the nearest centimeter (Appendix 1). For large collections of the target species, a random subsample consisting of thirty to fifty individuals was weighed and individuals were measured. Depending on the species, measurements were recorded as total length, fork length, or carapace width. For the penaeid shrimp, *Litopenaeus setiferus*, *Farfantepenaeus aztecus*, and *F. duorarum*, formerly *Penaeus* (Perez-Farfante and Kensley, 1997), total length (mm), sex, female ovarian development, male spermatophore development, and occurrence of mated females were noted. Carapace width (mm), individual weight, sex, and presence and developmental stage of eggs were recorded for *Callinectes sapidus*. Individuals of all shark species were weighed, measured to the nearest centimeter (both total length and fork length), and sex was noted.

Hydrographic data collected at each station included surface and bottom temperature and salinity measurements taken with a CTD profiler, sampling depth, and an estimate of wave height. In addition, atmospheric data on air temperature, barometric pressure, precipitation, and wind speed and direction were also noted at each station.

Data Analysis

The SAB was separated into six regions for data analysis (Figure 1). Raleigh Bay (RB), Onslow Bay (OB) and Long Bay (LB) were each considered to be regions. South Carolina, excluding Long Bay (SC), Georgia (GA), and northern Florida (FL) were also treated as separate regions.

Data from the paired trawls were pooled for analysis to form a standard unit of effort (tow). Density estimates, expressed as number of individuals or kilograms per hectare (ha), were standardized by dividing the mean catch per tow by the mean area (ha) swept by the combined trawls. Mean area swept by a net was calculated by multiplying the width of the net opening (13.5 m) as determined by Stender and Barans (1994) by the distance (m) trawled, calculated from starting and ending coordinates, and dividing the product by 10000 m^2/ha. Only those data collected in the inner strata are included in general discussions.

Results for *Leiostomus xanthurus*, *Micropogonias undulatus*, *Cynoscion regalis*, *Scomberomorus cavalla*, *S. maculatus*, *Litopenaeus setiferus*, *Farfantepenaeus aztecus*, *F. duorarum*, and selected coastal sharks are presented and discussed individually in this report. Statistically significant differences in lengths of individuals among regions and seasons were determined using the non-parametric Kruskal-Wallis test (Sokal and Rohlf, 1981). Contingency tables using the G-statistic were used to determine if occurrence of ripe penaeid shrimp was independent of season and region. Chi-square analysis was used to detect significant deviations from unity of penaeid shrimp sex ratios.

RESULTS AND DISCUSSION

Hydrographic Measurements

Hydrographic patterns of temperature and salinity in the SAB are driven by four major influences which fluctuate seasonally: river run-off, the Gulf Stream, a southerly flowing coastal current, and atmospheric conditions. The warm, highly saline waters of the Gulf Stream, in close proximity to coastal waters off Florida and in Raleigh Bay, elevate temperatures and salinities in those areas (Pietrafesa et al., 1985). Most of the river run-off in the SAB occurs south of Cape Fear (Blanton and Atkinson, 1983; McClain et al., 1988). Water of lower salinity created by freshwater influx is pushed southward by the southerly flowing coastal current; however, this movement is impeded by the northerly flowing Gulf Stream off northern Florida (Blanton, 1981; Blanton and Atkinson, 1983). The result of this process is a concentration of lower salinity water off southern South Carolina and Georgia. Seasonal fluctuations in river run-off, atmospheric conditions, and migrations of the Gulf Stream dictate the magnitudes of these hydrographic patterns.

Generally typical seasonal and regional patterns of temperature and salinity were observed in 1999 (Table 1), with temperatures and salinities being lower in spring and fall and higher in summer. Salinities were slightly higher than average (33.6‰ 1990-1999) in spring, possibly due to reduced rainfall preceding the spring cruise. Summer temperatures and salinities were about average (27.3°C and 35.3‰ 1990-1999). Fall water temperatures tracked close to average (22.0°C) as well. However, while salinities in Raleigh Bay and off Florida in fall were about average, salinities in the waters between ranged from one to two parts per thousand lower possibly due to increased fresh water influx from North Carolina sounds and South Carolina rivers.

Hurricane Floyd struck the North Carolina coast September 17, 1999. In response to reports that rivers in North Carolina and northern South Carolina were experiencing extensive flooding due to rainfall from Hurricane Floyd and other fall storms that brushed the coast, four hydrographic transects were made to collect ancillary data on the event (Appendix 2). A single transect was sampled outside the mouth of the Cape Fear River in North Carolina. The presence of a 3-5‰ halocline at two to four meters from the surface evident out to at least 14 nautical miles offshore seemed to confirm the presence of a plume of fresher water. By the following morning, the plume had, most likely, shifted inshore as data collected at a nearby SEAMP-SA station (less than two nautical miles from the transect and sampled twelve hours after the Cape Fear transect) failed to indicate a strong halocline and closely resembled data collected historically during fall cruises in the area. Three discreet transects were sampled on separate days from the mouth of Winyah Bay, SC seaward. While these indicated varying amounts of fresh water influence, salinity was markedly lower close to shore. Presence or absence of stratification at these stations was most likely the result of wind and sea conditions at the time, although it is also possible that the higher salinities seen in bottom waters on October 15 and November 07 indicate a return to more normal conditions. Historically, no previously sampled SEAMAP-SA station data fell within the general path of the Winyah Bay transects.

Species Composition

The 1999 sampling effort resulted in the collection of 191 species (Appendix 3) from all inner and outer strata. Effort in inner strata consisted of 234 trawl tows and produced 180 species of which 115 species were finfish, 24 species were elasmobranchs, 36 species were decapod crustaceans, 2 species were stomatopod crustaceans, and 3 genera of cephalopods. Twenty-seven trawl

Table 1. Seasonal mean bottom temperatures (°C) and salinities (‰) from each region in 1999. Regions are abbreviated as follows: Raleigh Bay (RB), Onslow Bay (OB), Long Bay (LB), South Carolina (SC), Georgia (GA), and Florida (FL).

	RB	OB	LB	SC	GA	FL	ALL REGIONS
SPRING							
$\bar{x}$ Temperature	17.6	16.8	17.2	18.9	21.5	22.8	19.3
$\bar{x}$ Salinity	35.5	34.8	34.2	34.0	33.8	36.0	34.4
SUMMER							
$\bar{x}$ Temperature	25.5	26.6	27.4	27.4	28.7	26.8	27.4
$\bar{x}$ Salinity	35.5	35.5	35.5	34.8	35.0	36.4	35.3
FALL							
$\bar{x}$ Temperature	21.2	22.1	22.0	21.1	21.6	25.5	22.1
$\bar{x}$ Salinity	34.5	33.8	32.8	31.4	31.8	34.2	32.6
ALL SEASONS							
$\bar{x}$ Temperature	21.4	21.8	22.2	22.5	23.9	25.0	22.9
$\bar{x}$ Salinity	35.1	34.7	34.2	33.4	33.5	35.5	34.1

samples were taken in outer strata in spring and 16 in fall, producing a total of 116 species, 81 of which were finfish, 6 were elasmobranchs, 27 were decapods, 2 were stomatopod, and 3 genera of cephalopods. Diversity increased by 15 species in the inner strata over 1998, mostly reflecting an increase in finfish and decapod crustacean species. However, the drop in diversity for the outer strata was twice that (30 species), primarily reflecting finfish and elasmobranch diversity.

The number of species varied somewhat seasonally among inner strata with the highest diversity in fall (Appendix 4). Diversity also varied among regions ranging from 86 species in Raleigh Bay to 133 species in Long Bay. Undoubtedly, this variability was partially due to unequal sampling effort among regions. However, with the exception of 1991, Long Bay has consistently yielded the highest number of species, with less effort than is directed to the neighboring region of South Carolina. This is possibly due to the relatively greater abundance of live bottom in the vicinity of trawl stations in Long Bay.

Abundance, Biomass, and Density Estimates

Total catch for all inner and outer strata from the 1999 survey was 345,502 individuals with a biomass of 17,995 kg. Miscellaneous invertebrates and algae contributed another 22,767 kg. of biomass. Inner strata yielded 296,006 specimens (1265 individuals/tow) for a total of 13,927 kg (59.5 kg/tow) plus an additional 22,601kg of miscellaneous invertebrate and algae biomass. The overall density of individuals for inner strata (342 individuals/ha) represents a slight decrease from the six year high in abundance seen in 1998 (Figure 2). Patterns of abundance in the SAB generally reflect the abundance of two members of the sciaenid family, the spot, *Leiostomus xanthurus*, and the Atlantic croaker, *Micropogonias undulatus,* which have been consistent in their numerical dominance among years. Atlantic croaker, *Micropogonias undulatus*, was the numerically dominant species, constituting approximately 18% of the total number of individuals in inner strata and 17% of overall abundance in 1999. Spot, *Leiostomus xanthurus*, ranked fourth in abundance in inner strata, after the white shrimp, *Litopenaeus setiferus*, and the Atlantic bumper, *Chloroscombrus chrysurus*. The level of abundance observed for spot in 1999 was yet another decline from the lowest abundance recorded of 1998. The white shrimp, *Litopenaeus setiferus,* was the most abundant decapod crustacean collected, followed by the spider crab, *Libinia dubia* and the portunid crab, *Portunus gibbesii*. The cow nose ray, *Rhinoptera bonasus,* usually a major contributor to overall biomass, ranked third in biomass behind the two numerically dominant sciaenids (Appendix 5).

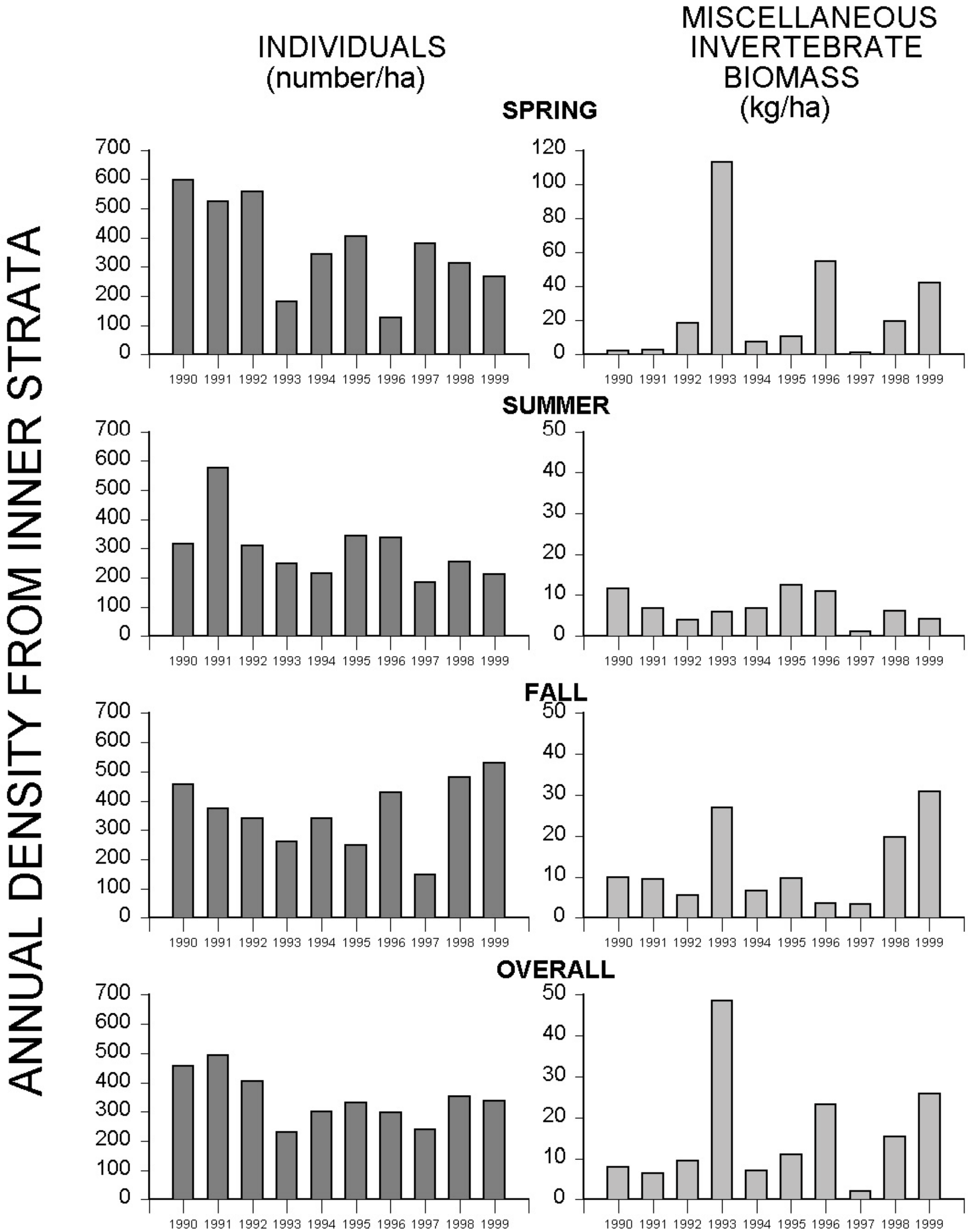

Figure 2. Annual densities from inner strata for 1990-1999.

While densities of biomass were similar in inner strata between spring and fall, density of abundance was over twice as great in fall. Density of both individuals and biomass was lowest in summer (Appendix 4). The density of individuals from fall 1999 was the greatest observed from 1990 -1999 (Figure 2). The highest regional density of individuals and biomass occurred in Raleigh Bay, reflecting relatively large catches of Atlantic croaker, white shrimp, and striped anchovies. Georgia and South Carolina had the lowest densities of biomass, due primarily to the absence of spot and Atlantic croaker in many tows (Appendix 5). Georgia and Florida had the lowest densities of abundance (Appendix 4).

In 1999, twenty-five sea turtles were taken in SEAMAP-SA trawls (Appendix 6). Twenty loggerhead sea turtles (*Caretta caretta*) and five Kemp's ridley turtles (*Lepidochelys kempi*) were removed from trawl catches alive. All turtles were measured, weighed, tagged with Inconel flipper tags supplied by NMFS, and released in good condition near the site of capture.

Distribution and Abundance of Spot, Atlantic Croaker, Weakfish, Mackerels, and Commercially Important Penaeid Shrimps

Micropogonias undulatus

The Atlantic croaker ranges from Argentina to the Gulf of Maine (Chao, 1978) and inhabits a wide range of habitats and salinities (Dahlberg, 1972). This species is one of the most abundant finfish species in trawl catches in the SAB (Wenner and Sedberry, 1989) and is considered to be an excellent food fish. In addition to trawls, croaker are also caught with pound nets, gill-nets, trammel nets and seines, and also on hook-and-line by sports fishermen (Chao, 1978). Spawning of Atlantic croaker takes place offshore, probably on the outer shelf or slope areas, over a 5 month period from mid-September to late February (Dahlberg, 1972; Warlen, 1982; Ross, 1988).

Micropogonias undulatus was the most abundant species collected in SEAMAP-SA samples in 1999. The 51,726 individuals (2597.3 kg) made up 18% of the total number of specimens taken in inner strata. While the density estimates for the inner strata over the entire SAB of 59.1 individuals/ha and 3.0 kg/ha were down slightly from the high abundance seen in 1998, fall density was the highest in the history of the survey (Figure 3). Atlantic croaker were collected in all regions in all seasons except Raleigh Bay in summer (Table 2). The highest regional and seasonal density of individuals occurred in Raleigh Bay in spring followed by Raleigh Bay in fall after a complete absence from summer collections there. Onslow Bay also exhibited fairly high regional density as a result of moderately large catches in all seasons. Outer strata produced 5474 specimens (33.5 individuals/ha). Fall collections produced 98% of these specimens.

A cooperating MARFIN aging study (Wenner et al. 1998) utilizing croaker collected by SEAMAP-SA from 1995 and spring 1996 found fish collected in SEAMAP-SA collections to be Ages 0-V. Size overlap for ages 0-3 was considerable. Very few Age IV or Age V fish were collected in SEAMAP-SA samples.

Total lengths of Atlantic croaker from inner strata in 1999 ranged from 8 to 26 cm ($\bar{x}$ = 16.8 cm, n =51,726). Lengths differed significantly among seasons (X^2 = 56.9, $p < 0.0001$). The mean length of Atlantic croaker increased seasonally from spring to summer, then decreased slightly in fall (Figure 4). The spring length-frequency distribution appeared to comprise mostly Age I and a few Age II fish. The distribution in summer seems to indicate subsequent growth of spring animals with the inclusion of some new YOY individuals. Fall

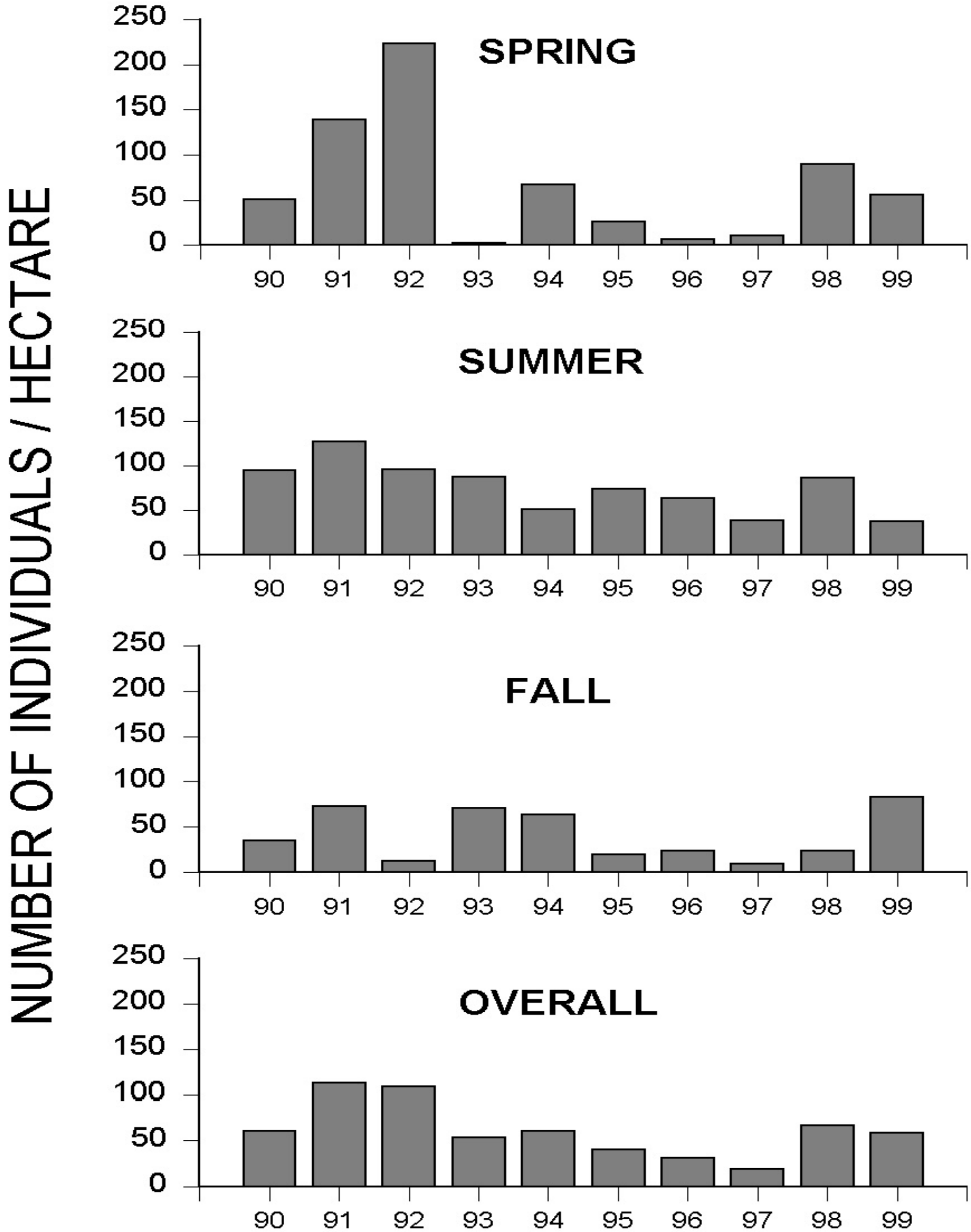

Figure 3. Annual densities of *Micropogonias undulatus* from inner strata.

Table 2. Estimates of density (number of individuals/hectare) for Atlantic croaker, spot, and weakfish among regions and seasons for 1999.

Micropogonias undulatus

	Spring	Summer	Fall	Region
Raleigh Bay	956.6	0.0	826.4	591.9
Onslow Bay	44.1	123.6	58.6	75.2
Long Bay	0.2	67.7	118.7	61.8
South Carolina	0.02	9.1	35.0	15.2
Georgia	0.3	0.4	5.8	2.2
Florida	8.6	36.9	0.05	15.4
Season	55.9	37.6	83.1	59.1

Leiostomus xanthurus

	Spring	Summer	Fall	Region
Raleigh Bay	21.5	28.2	7.3	18.9
Onslow Bay	62.2	51.3	58.5	57.5
Long Bay	55.6	15.4	10.4	27.3
South Carolina	1.7	18.7	3.6	7.9
Georgia	0.5	5.4	2.5	2.7
Florida	4.6	92.5	3.7	34.2
Season	22.1	29.8	11.8	21.2

Cynoscion regalis

	Spring	Summer	Fall	Region
Raleigh Bay	131.9	0.0	40.6	59.3
Onslow Bay	0.6	0.3	3.9	1.6
Long Bay	0.4	1.7	2.5	1.5
South Carolina	0.6	1.4	3.9	2.0
Georgia	1.0	0.04	1.8	1.0
Florida	1.4	0.9	0.1	0.8
Season	7.7	0.9	4.5	4.4

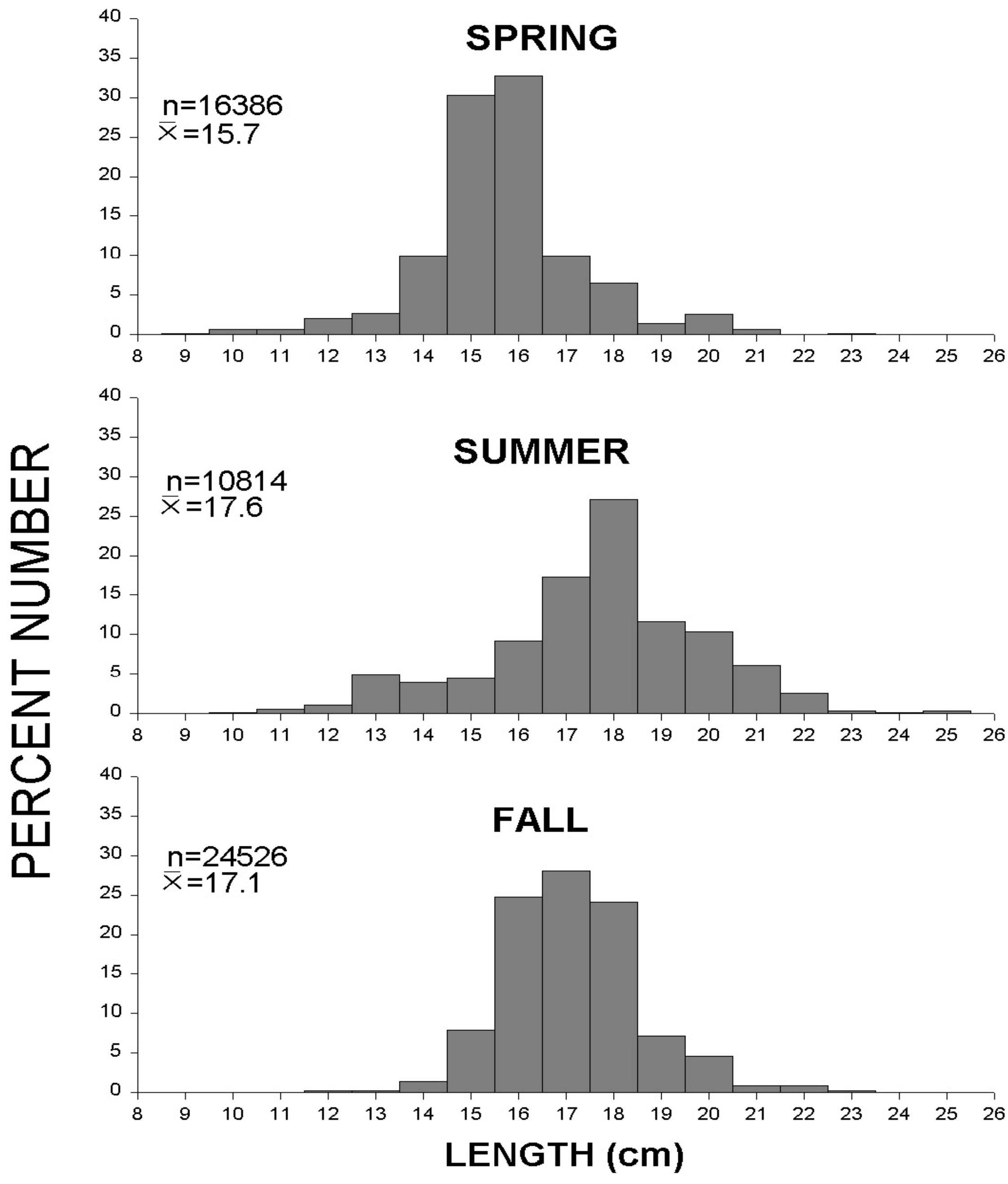

Figure 4. Seasonal length-frequencies of *Micropogonias undulatus* from inner strata in 1999.

collections consisted of mostly Age I, YOY, and a few Age II fish. Based on length-at-age data, in all seasons the numerically dominant fish were probably Age 0 and Age I, with a few Age II fish present, primarily in spring. Length also varied significantly among regions ($X^2 = 78.1$, $p < 0.0001$), and mean lengths ranged from 15.0 cm off Florida to 17.7 cm in Raleigh Bay (Figure 5).

Leiostomus xanthurus

The spot ranges from Massachusetts throughout the Gulf of Mexico to the mouth of the Rio Grande (Chao, 1978) and is one of the most widely occurring and abundant fishes in the coastal waters of the South Atlantic Bight (Anderson, 1968; Keiser, 1976; Wenner and Sedberry, 1989). Spot migrate offshore to spawn in early November through late January (Flores-Coto and Warlen, 1993) and are subjected to heavy commercial and recreational fishing pressure at that time. Historically, the largest spot fishery has been the commercial gill-net fishery, which has contributed to great fluctuations in commercial landings over the last 60 years (Mercer, 1989). Furthermore, recreational landings have been estimated to exceed commercial landings for the last several years (Office of Fisheries Management, South Carolina Department of Natural Resources). No discernable pattern nor definitive causative factors have been reported to explain the fluctuations in spot landings. It is reasonable to assume, however, that changes in abundance of a numerically dominant species, such as *L. xanthurus*, must greatly affect the community in which it lives.

Leiostomus xanthurus was the fourth most abundant species collected by SEAMAP-SA in 1999. The 18,538 (21.2 individuals/ha) spot collected in the inner strata weighed 875.6 kg (1.0 kg/ha). Density of abundance in 1999 was the lowest annual density ever recorded by the survey (Figure 6). Spot were collected in all regions in all seasons, with greatest density of abundance occurring in waters off Florida in summer (Table 2). Densities were found to be moderately high in Onslow Bay throughout the year. Over all regions, density of abundance peaked in summer, then declined to the lowest point in fall. The lowest regional density was observed off Georgia. In the outer strata, 3,701 spot were collected. Raleigh Bay yielded 97% of these in the fall.

Aging studies have shown that the vast majority of spot are two years old or younger, with some individuals at age III and very few reaching the age of IV or V (Hildebrand and Cable, 1930; Dawson, 1958; Pacheco, 1962; DeVries, 1982; Music and Pafford, 1984). An aging study (Wenner et al. 1998) conducted by a cooperating MARFIN project using spot collected by SEAMAP-SA in 1995 and spring of 1996 substantiated that spot collected by SEAMAP-SA in the SAB are predominantly Age 0 - 2. Very few Age III and Age IV have been collected from SEAMAP-SA samples.

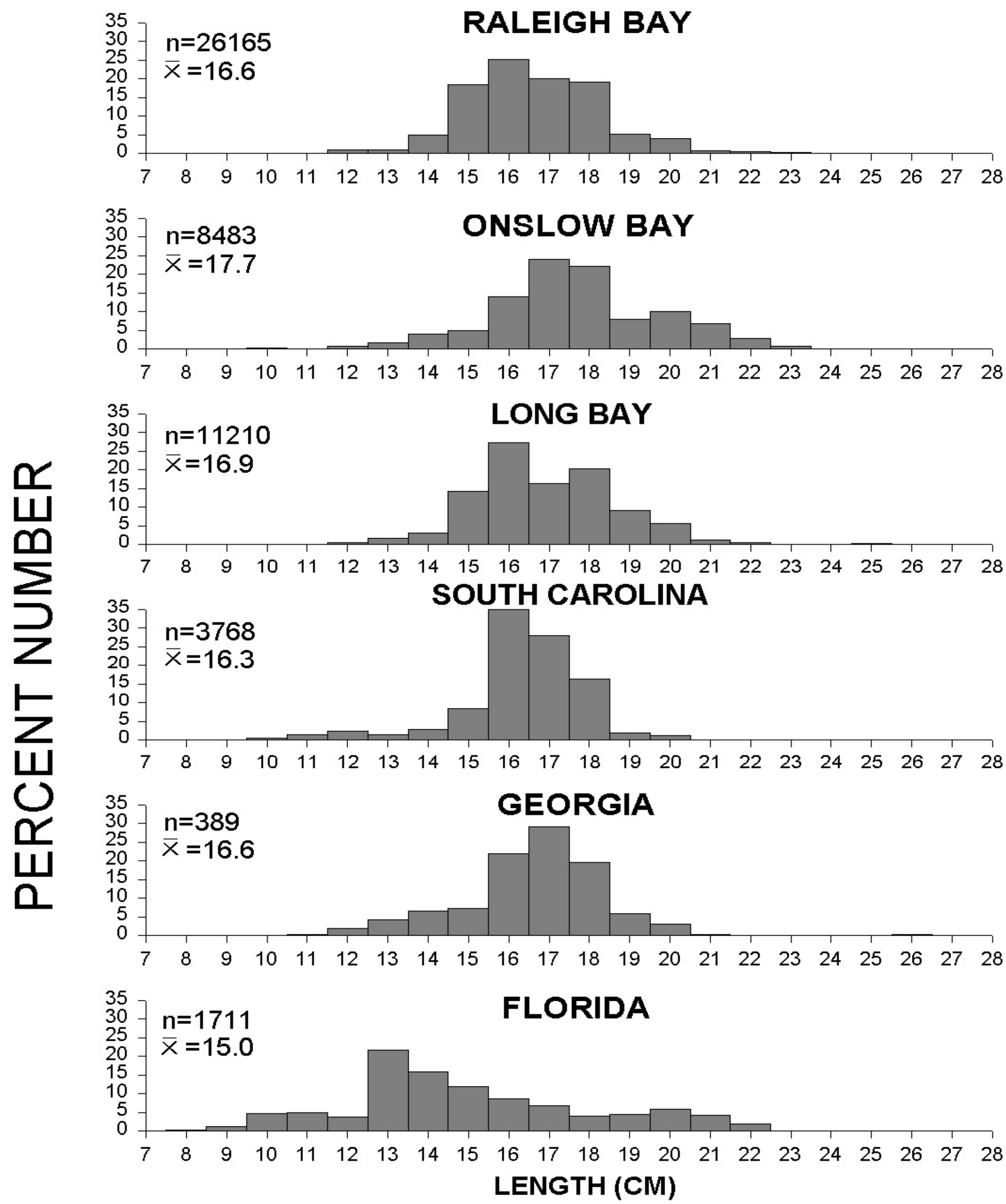

Figure 5. Regional length-frequencies of *Micropogonias undulatus* from inner strata in 1999.

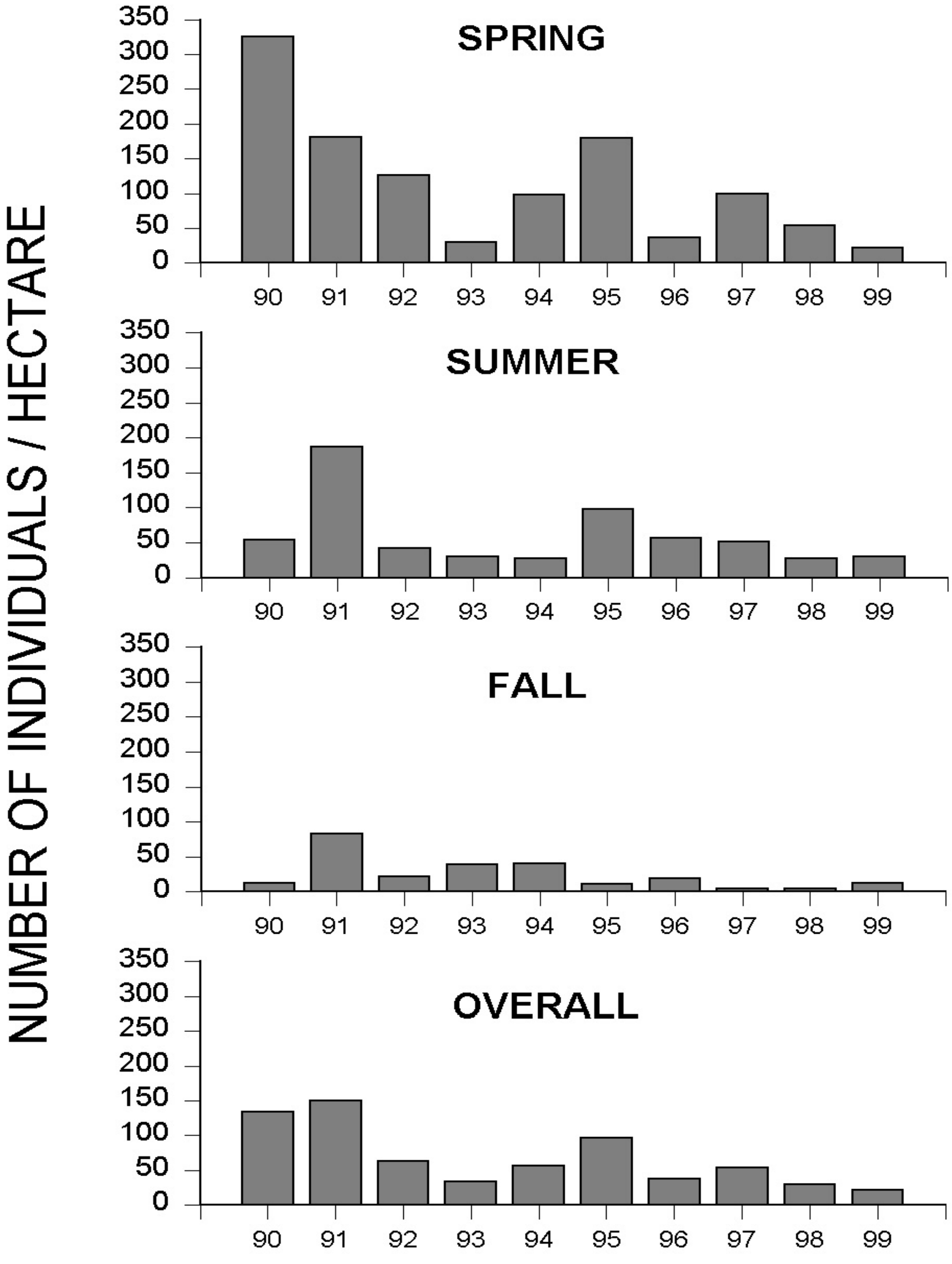

Figure 6. Annual densities of *Leiostomus xanthurus* from inner strata.

Total lengths of spot from the 1999 SEAMAP-SA survey ranged from 7 to 25 cm in inner strata, with a mean length of 14.5 cm (n = 18,538). Spot collected appeared to be fish of ages 0, I and II. Lengths varied significantly among seasons ($X^2 = 22.2$, $p < 0.0001$). The mean length of spot decreased slightly from spring to summer, due to the recruitment of YOY individuals. Mean length was greatest in fall collections (Figure 7).

Length also varied significantly among regions ($X^2 = 20.1$, $p < 0.005$) (Figure 8). The length-frequency distribution of spot in Raleigh Bay largely represents specimens collected in spring and summer. Less than 13% of the spot taken in Raleigh Bay were from fall collections. Fish collected during the spring cruise predominated in the regional length-frequency distribution from Long Bay (69%). Florida waters produced the greatest regional mean length. While numbers were fairly low, spring and fall collections produced consistently larger fish than summer collections.

Cynoscion regalis

Weakfish occur along the Atlantic coast of the United States from Nova Scotia to southern Florida and occasionally to the Gulf coast of Florida (Bigelow and Schroeder, 1953; Chao, 1978). Some adult weakfish utilize estuaries in spring and summer as spawning and feeding grounds, although most spend their summers in oceanic waters (Hill, 1984; Mercer, 1985). Spawning takes place in estuarine and near shore waters from March to October, with the peak spawning period occurring from late April through June (Welsh and Breeder, 1923; Hildebrand and Cable, 1934; Pearson, 1941; Dahlberg, 1972; Merriner, 1976; Powles and Stender, 1978). Weakfish in the SAB are reported to move south from waters off North Carolina to Florida during fall migrations (Mercer, 1985). The weakfish is an important commercial and recreational species, primarily caught by hook-and-line, gill-nets, and bottom trawls (Bigelow and Schroeder, 1953; Thomas, 1971; Chao, 1978; Mercer, 1985).

Inner strata yielded a total of 3,841 weakfish (4.4 individuals/ha) weighing 228.0 kg (0.3 kg/ha). Density of individuals was one third of that seen in the peak year of 1998 (Figure 9). Weakfish were taken in all seasons in all regions except Raleigh Bay in summer (Table 2). Approximately 59% of all weakfish taken in inner strata were collected during the spring cruise. Density was greatest in spring and lowest in summer. The high densities of individuals seen in spring and fall were primarily due to large collections from Raleigh Bay. Outer strata produced 598 specimens, 91% of which came from fall collections.

The MARFIN aging study (Wenner et al. 1998) utilizing specimens collected by SEAMAP-SA from 1995-1997 found that fish Age 0 and 1 predominated in collections, with small numbers of Age 2-3 fish present much of the time. Age 4 and 5 fish were mostly limited to very small numbers in fall collections.

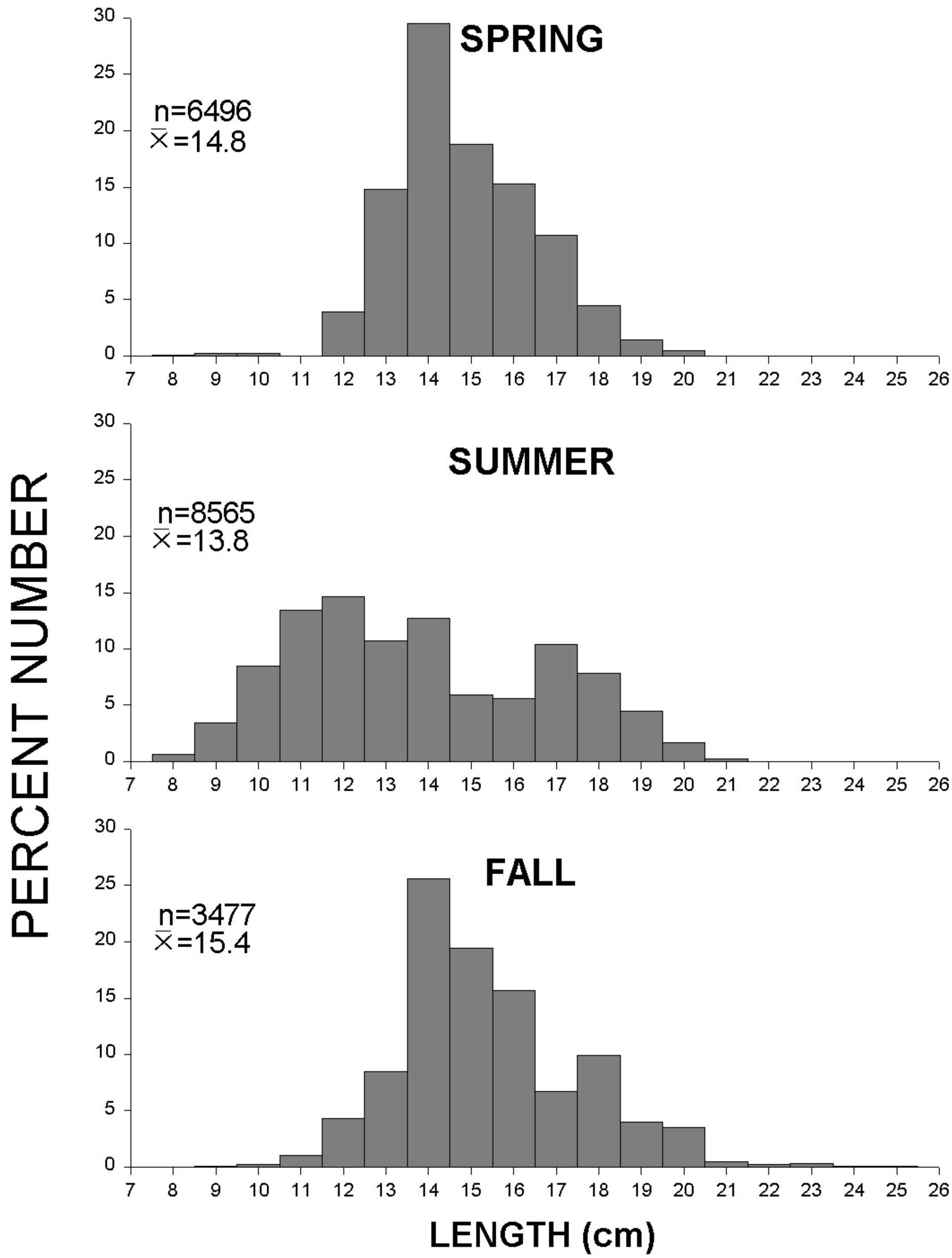

Figure 7. Seasonal length-frequencies of *Leiostomus xanthurus* from inner strata in 1999.

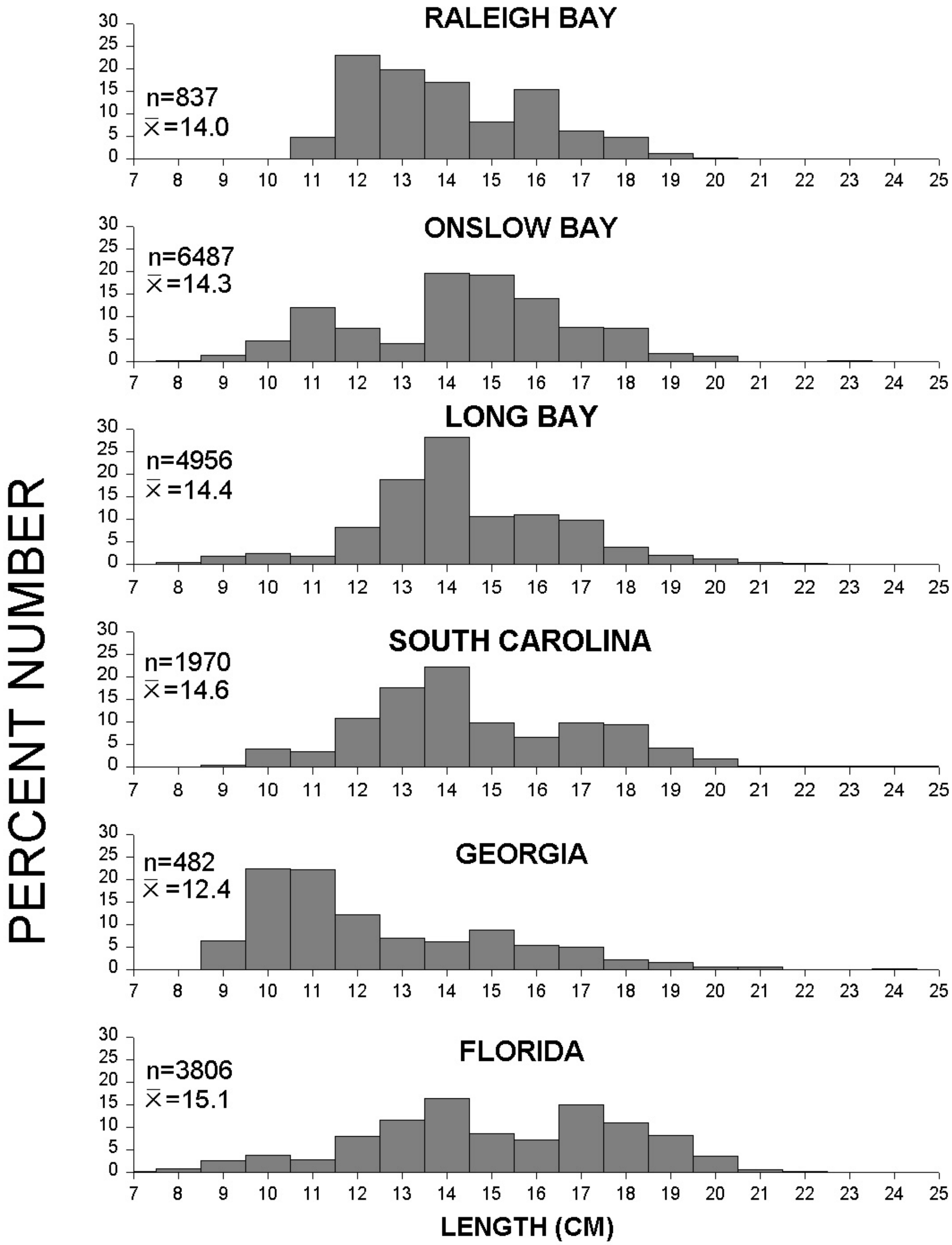

Figure 8. Regional length-frequencies of *Leiostomus xanthurus* from inner strata in 1999.

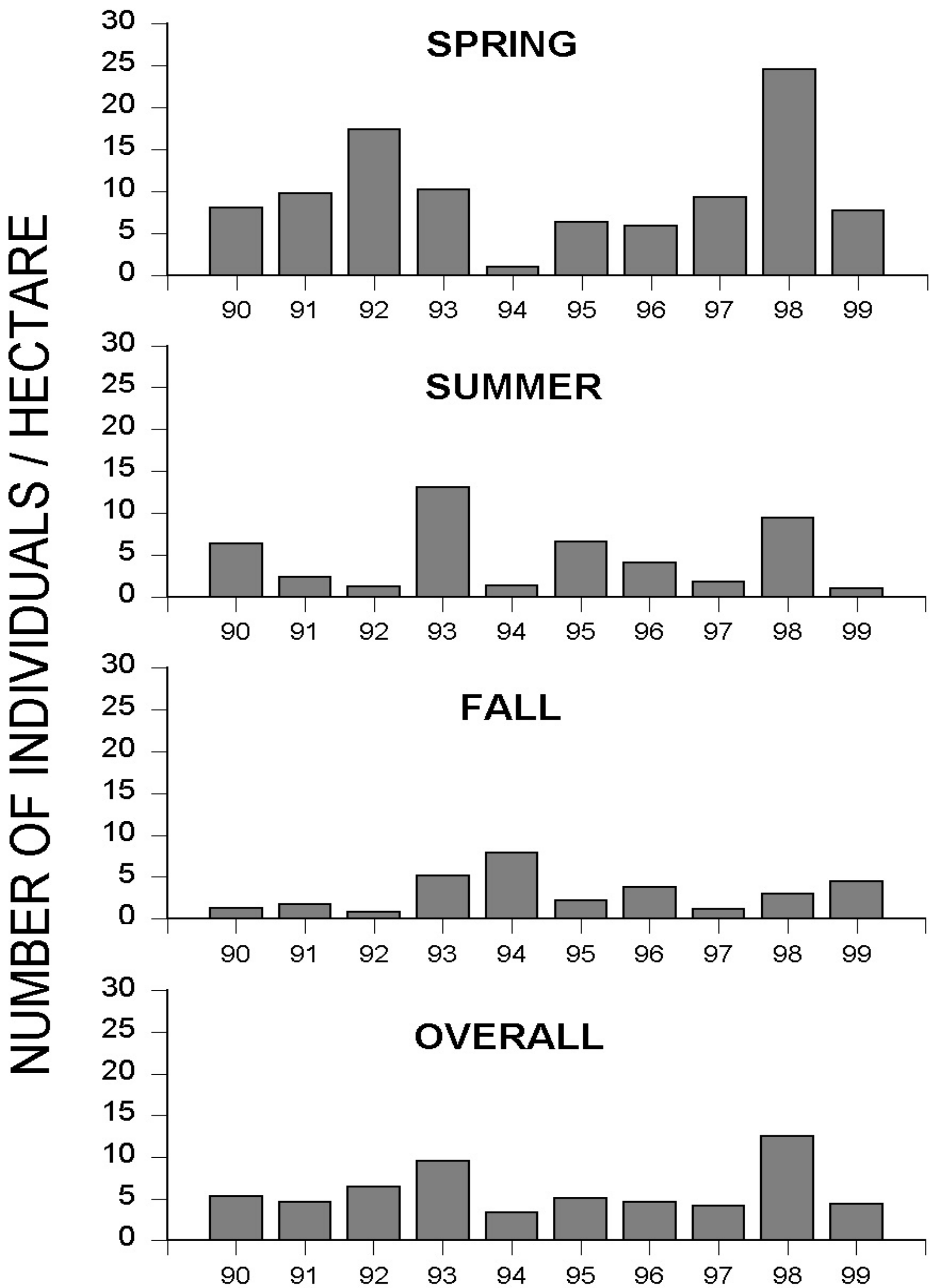

Figure 9. Annual densities of *Cynoscion regalis* from inner strata.

Total lengths of *Cynoscion regalis* ranged from 6 to 38 cm ($\bar{x}$ = 18.0, n = 3,841). Length was significantly different among seasons ($X^2 = 39.2$, $p < 0.0001$). Mean length decreased from spring to summer, indicating the recruitment of YOY individuals, and increased in fall as the result of subsequent juvenile growth (Figure 10). Mean length also varied significantly among regions ($X^2 = 80.4$, $p < 0.0001$), with Florida and Onslow Bay producing larger fish on average (Figure 11). Although Long Bay exhibited the shortest mean length, some of the largest individuals were collected there. The length-frequency distribution of weakfish in Raleigh Bay represents approximately 68% of all weakfish taken from inner strata, with most of the smaller fish collected in summer and the larger fish in fall collections. Only 22% of the weakfish from Raleigh Bay were caught in fall. However, over 50% of the animals seen from Onslow Bay to Georgia were collected in fall; the smaller individuals in these regional length-frequency distributions were taken in summer and fall.

Scomberomorus maculatus

Spanish mackerel range from the Gulf of Maine to the Yucatan Peninsula, where they are replaced by *Scomberomorus brasiliensis* from Belize to Brazil (Collette and Russo, 1984). Generally occurring in coastal waters at depths of less than 72 m, S*. maculatus* are known to enter estuaries occasionally (Fritzsche, 1978). An excellent food fish, this species is the target of recreational anglers and supports a large purse-seine and gill-net fishery (Fritzsche, 1978). Schmidt et al. (1993) reported that spawning in the Atlantic group of Spanish mackerel occurs from spring through summer and that ripe males are present from spring through early fall.

Sampling in 1999 produced 1275 Spanish mackerel that weighed a total of 133.2 kg (1.5 individuals/ha; 0.2 kg/ha). While abundance was down from 1998, biomass was up by 50% (Figure 12). The highest densities of Spanish mackerel were found off Georgia in spring and off Florida in summer (Table 3). Raleigh Bay yielded the lowest density as Spanish mackerel were only collected there in fall. Density declined from spring through fall. Outer strata produced 21 Spanish mackerel, all from spring collections.

Fork lengths of Spanish mackerel ranged from 3 to 45 cm ($\bar{x}$ = 21.0 cm, n = 1275) (Figure 13). The greater biomass seen in 1999 is largely the result of a 4 cm greater mean length than seen in 1998. Lengths differed significantly among seasons ($X^2 = 153.9$ $p < 0.0001$). By the end of their first year, Spanish mackerel

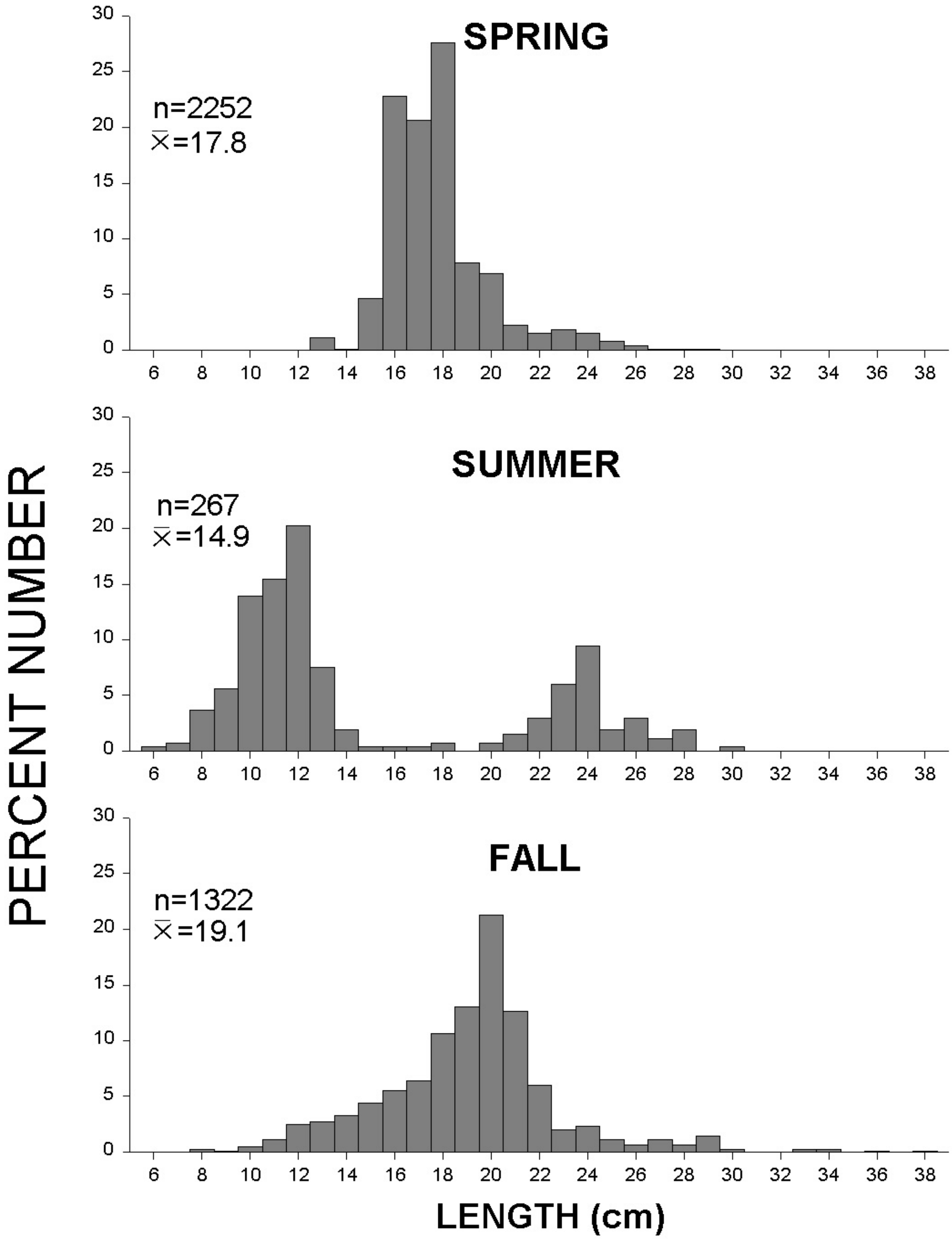

Figure 10. Seasonal length-frequencies of *Cynoscion regalis* from inner strata in 1999.

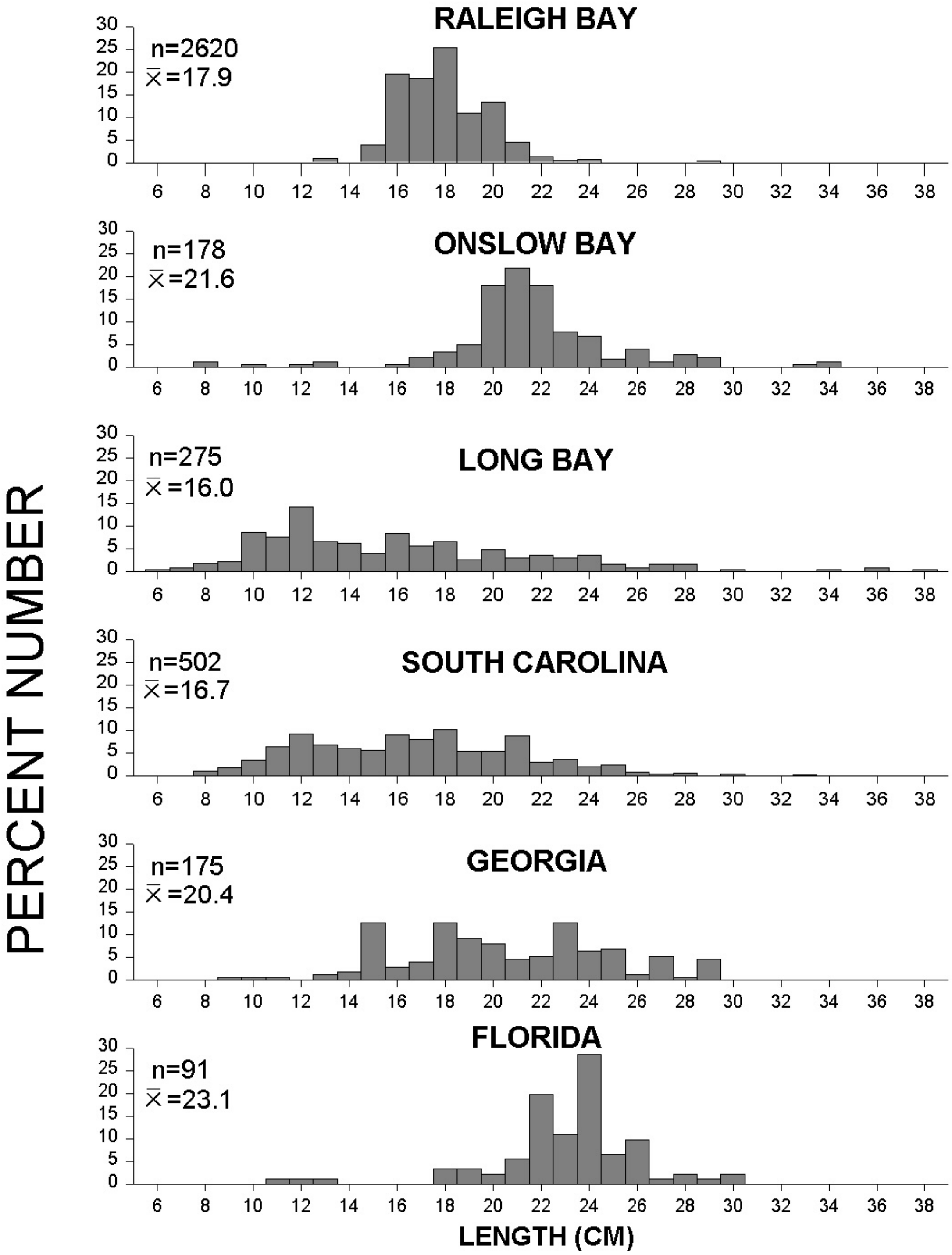

Figure 11. Regional length-frequencies of *Cynoscion regalis* from inner strata in 1999.

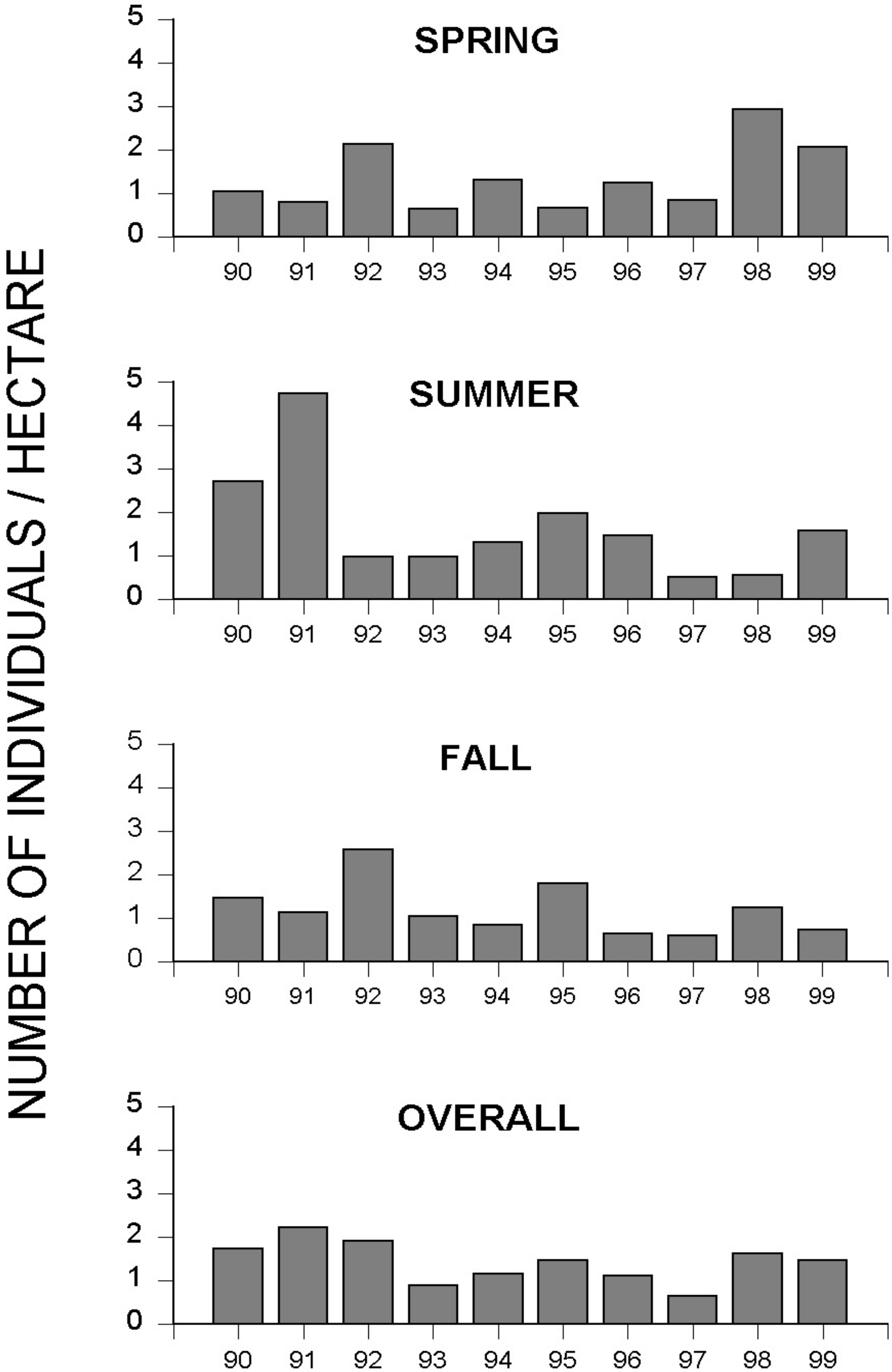

Figure 12. Annual densities of *Scomberomorus maculatus* from inner strata.

Table 3. Estimates of density (number of individuals/hectare) for mackerel among regions and seasons for 1999.

Scomberomorus maculatus

	Spring	Summer	Fall	Region
Raleigh Bay	0.0	0.0	0.3	0.1
Onslow Bay	0.03	0.1	0.4	0.2
Long Bay	1.6	0.8	0.6	1.0
South Carolina	1.8	0.8	0.1	0.9
Georgia	5.6	0.9	1.5	2.7
Florida	0.5	7.5	1.7	3.3
Season	2.1	1.6	0.7	1.5

Scomberomorus cavalla

	Spring	Summer	Fall	Region
Raleigh Bay	0.0	0.0	0.0	0.0
Onslow Bay	0.0	0.6	0.2	0.3
Long Bay	0.0	0.3	0.3	0.2
South Carolina	0.2	0.7	0.1	0.3
Georgia	1.3	0.04	0.5	0.6
Florida	0.2	1.5	0.7	0.8
Season	0.4	0.5	0.3	0.4

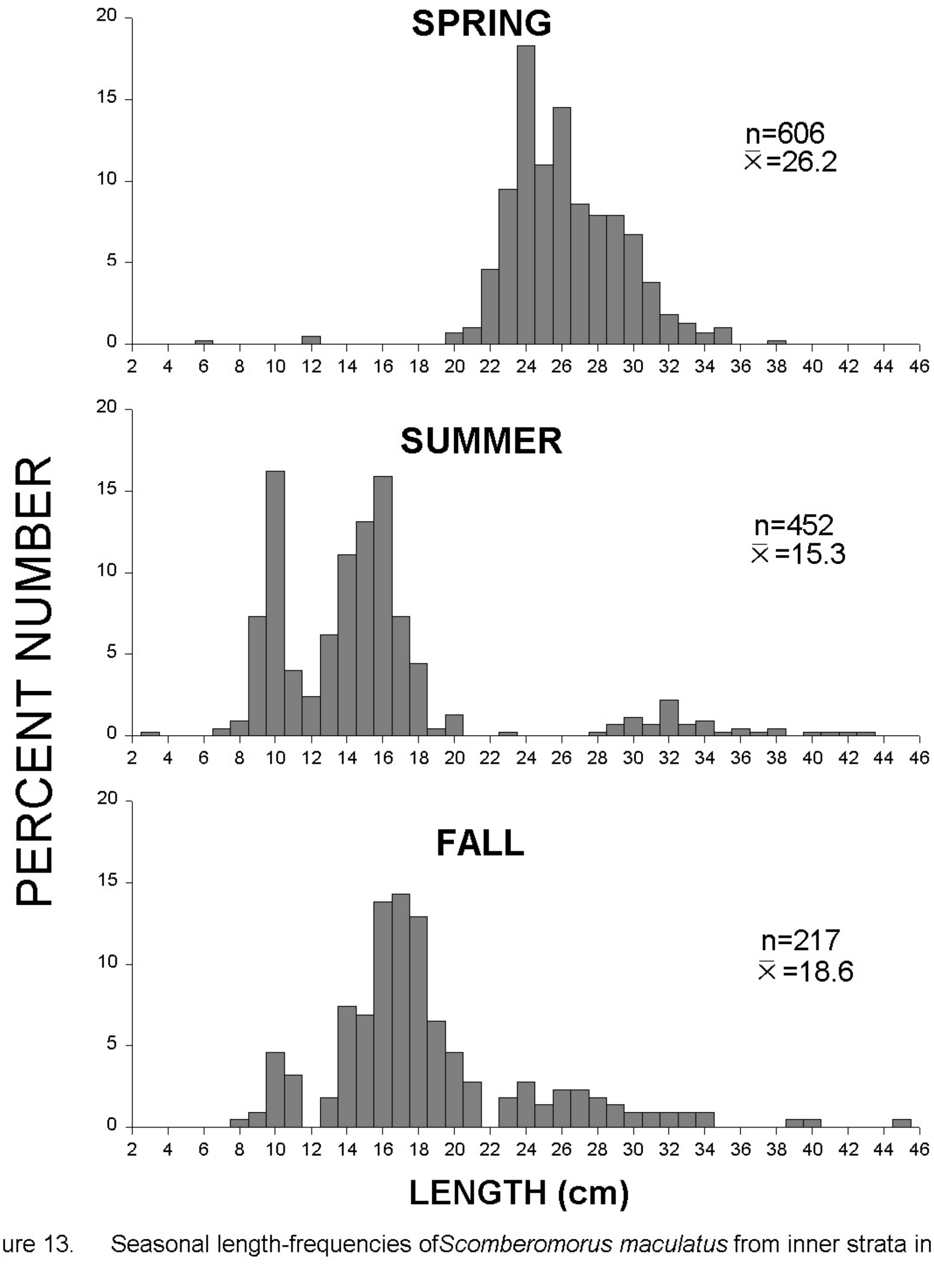

Figure 13. Seasonal length-frequencies of *Scomberomorus maculatus* from inner strata in 1999.

reach lengths greater than 30 cm (Powell, 1975). Specimens collected in spring were generally fish ending their first year. Summer collections contained primarily newly recruited YOY with a few representatives of the previous year-class still present. Fall collections were made up of fish from both the 1998 and current (1999) year-classes. Length also varied significantly among regions ($X^2 = 76.3$, $p < 0.0001$), and mean lengths ranged from a low of 14.8 cm off Florida to 25.3 cm in Raleigh Bay (Figure 14).

Scomberomorus cavalla

The king mackerel inhabits Atlantic coastal waters from Massachusetts south throughout the Gulf of Mexico and the Caribbean to Rio de Janeiro (Collette, 1978), possibly extending as far north as Maine (Fritzsche, 1978; Berrien and Finan, 1977). Atlantic stocks of king mackerel migrate northward from Florida during the warmer spring and summer months and return south as the waters get colder (Berrien and Finan, 1977), occurring singly or in small groups (Collette, 1978). Commercially, this species is the target of large purse-seine, gill-net, and hook-and-line fisheries (Collette, 1978). King mackerel spawn from May through September, with a peak in spawning activity in July (Finucane et al., 1986). Tag returns support the theory that two king mackerel stocks occur, a Gulf of Mexico stock and an Atlantic stock, with co-occurrence of these groups south of Naples on the west coast of Florida during warmer months and on the Atlantic coast in the area of Cape Canaveral during colder months (Sutter et al., 1991). The king mackerel that we collect are, therefore, primarily Atlantic stock with possibly a few individuals from the Gulf stock in fall collections from strata off Florida.

The 349 (0.4 individuals/ha) king mackerel collected from inner strata during the 1999 survey weighed 31.6 kg (0.04 kg/ha). This is less than one third the peak density of king mackerel seen in 1998 (Figure 15). Similar to Spanish mackerel, biomass did not drop as drastically as abundance. Also as with Spanish mackerel, greatest densities of individuals were taken from strata off Georgia in spring and off Florida in summer (Table 3). King mackerel were absent from collections in Raleigh Bay in all seasons and from collections in Onslow and Long Bays in spring. Outer strata produced 32 king mackerel. As with Spanish mackerel, all came from spring collections.

Fork lengths of *Scomberomorus cavalla* ranged from 5 to 40 cm ($\bar{x} = 18.9$ cm, $n = 349$)(Figure 16), during the 1999 SEAMAP-SA survey, and represented two year-classes. Mean length was over 4 cm greater than that seen in 1998. Annual cohorts of king mackerel are spawned in spring and summer (Finucane et al., 1986) and reach mean lengths greater than 40 cm by the end of their first year (Collins et al., 1989). Lengths were significantly different among seasons ($X^2 = 76.1$, $p < 0.0001$). Most individuals from spring are ending their first year. The separate groupings of fish less than 20 cm and greater than 28 cm in summer

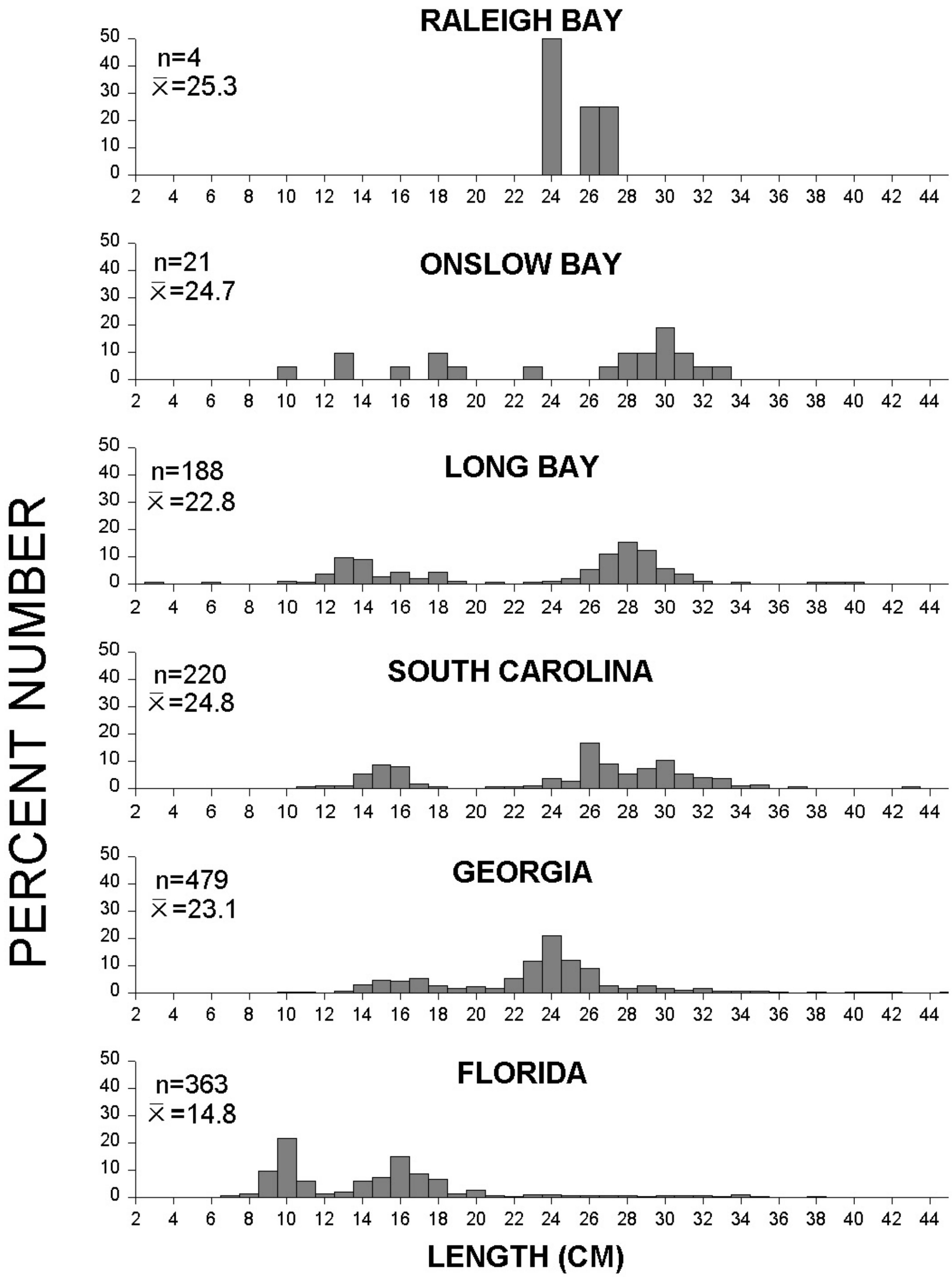

Figure 14. Regional length-frequencies of *Scomberomorus maculatus* from inner strata in 1999.

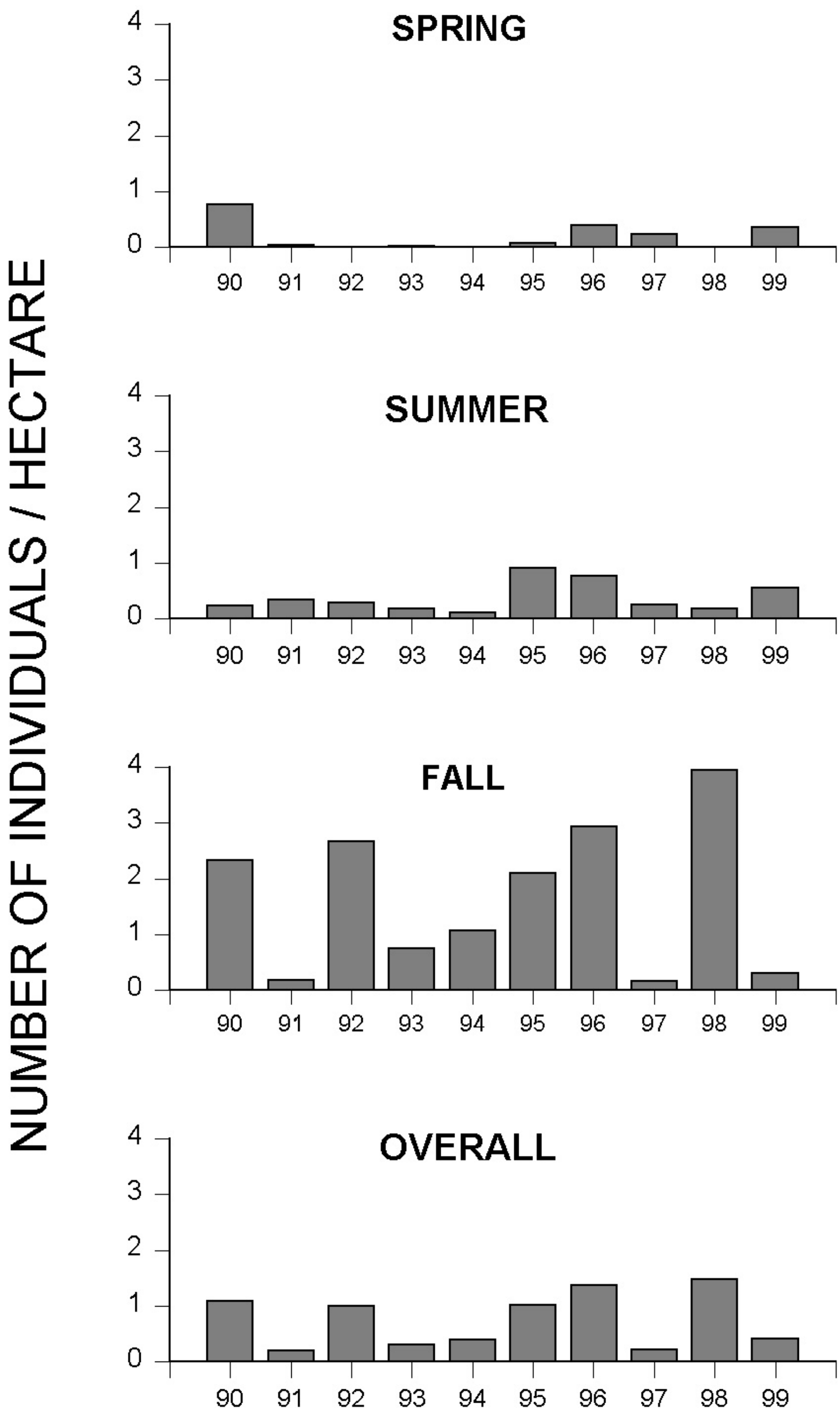

Figure 15. Annual densities of *Scomberomorus cavalla* from inner strata.

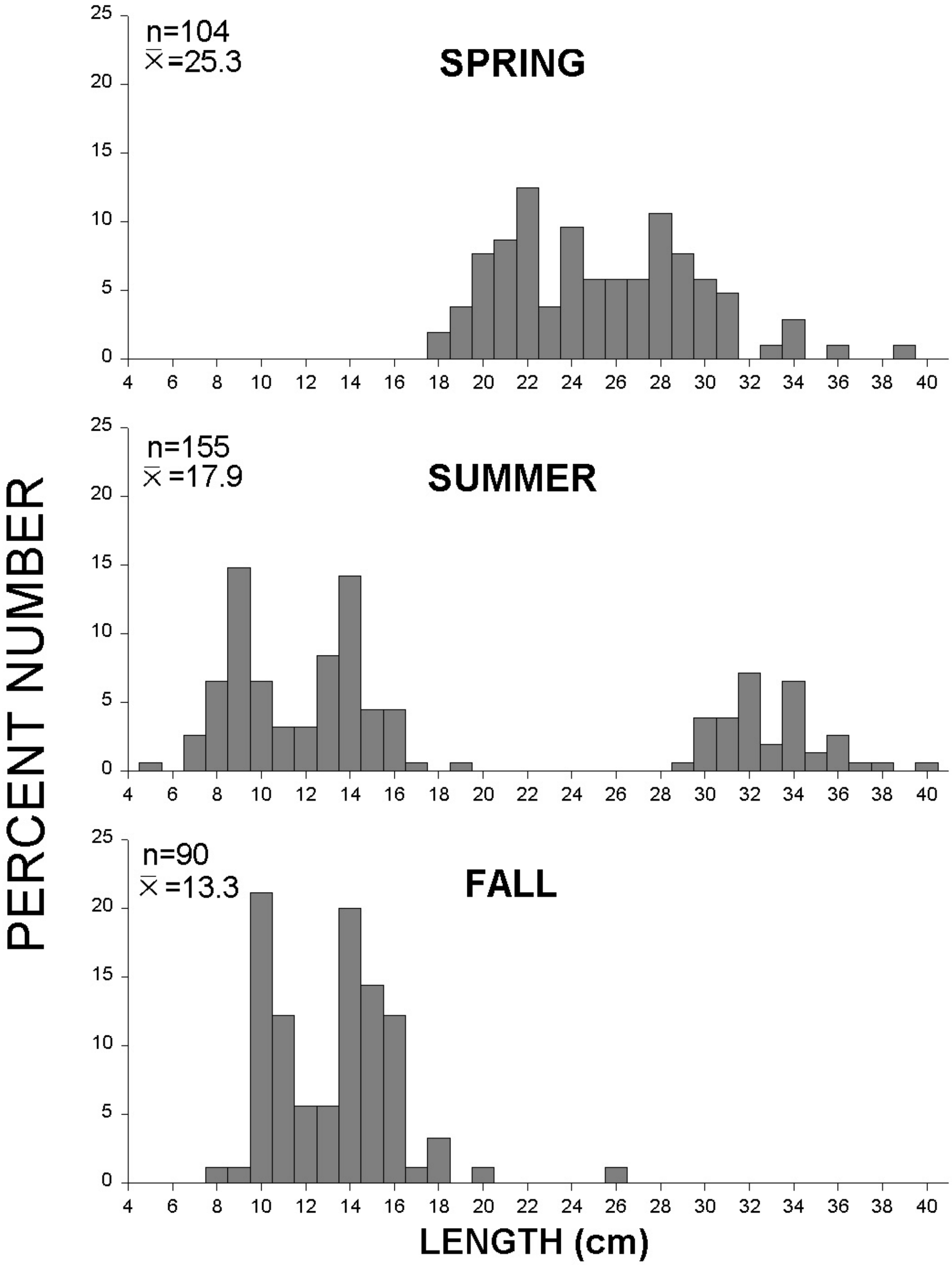

Figure 16. Seasonal length-frequencies of *Scomberomorus cavalla* from inner strata in 1999.

suggest that recruitment is beginning and that a few specimens from the Age I year class are still present. Fall seems to be entirely new recruits. Lengths varied significantly among regions ($X^2 = 50.3$, $p < 0.0001$) and mean lengths ranged from 13.6 cm for king mackerel off Florida to 28.1 cm for those in Onslow Bay (Figure 17).

Litopenaeus setiferus

The geographical range of white shrimp, formerly *Penaeus setiferus* (Perez-Farfante and Kensley, 1997), extends from New York to southern Florida and throughout the Gulf of Mexico (Perez-Farfante, 1978; Williams, 1984). White shrimp spawning in the SAB begins in May and continues into September (Lindner and Anderson, 1956; Williams, 1984). Centers of abundance along the Atlantic coast of the United States are found in waters off northeastern Florida, Georgia, and South Carolina (Perez-Farfante, 1978; Williams, 1984), where the species supports a large commercial fishery (South Atlantic Fishery Management Council, 1981).

White shrimp was the most abundant commercially important penaeid species from inner strata in the SEAMAP-SA Trawl Survey in 1999 (n=30,479, 714.7 kg) and ranked second in abundance overall. The 1999 annual density of abundance (34.8 individuals/ha) of *L. setiferus* was almost twice the greatest annual density for this species observed by this survey in 1998 (Figure 18). In spring, densities were highest in the southern half of the SAB. However, it was the high densities seen in fall that made a record year (Table 4). In the estuaries, the drop in salinity that resulted from fall hurricanes may have provided a stronger cue for egress than normal for these animals (Appendix 2). Greatest regional densities of abundance were found off South Carolina and Long Bay. Outer strata produced only 161 white shrimp, the majority of which (87%) were taken in spring collections.

Total lengths of *L. setiferus* ranged from 8 to 20 cm, with a mean length of 14.3 cm (n = 30,479). There was a significant difference in mean length among seasons ($X^2 = 141.7$, $p < 0.0001$). Although mean length was greatest in summer, smaller YOY individuals had already begun moving out of the estuaries and continued to do so into the fall (Figure 19). *L. setiferus* inhabits estuaries until nearing maturity when they move offshore (Williams, 1984), where they are susceptible to capture by trawl. Regional mean lengths also differed significantly ($X^2 = 21.5$, $p < 0.001$). Long Bay produced the smallest mean length (13.9 cm) and Raleigh Bay the greatest (15.9 cm) (Figure 20).

The ratio of male to female white shrimp (1:1.27) was significantly different from unity ($X^2 = 434.9$, $p < 0.001$) in 1999. White shrimp are reported to spawn from May through September in the SAB (Lindner and Anderson, 1956; Williams, 1984). The percentage of males with fully developed spermatophores peaked in summer (86%), decreasing to less than 1% in fall, when 81% of the males taken

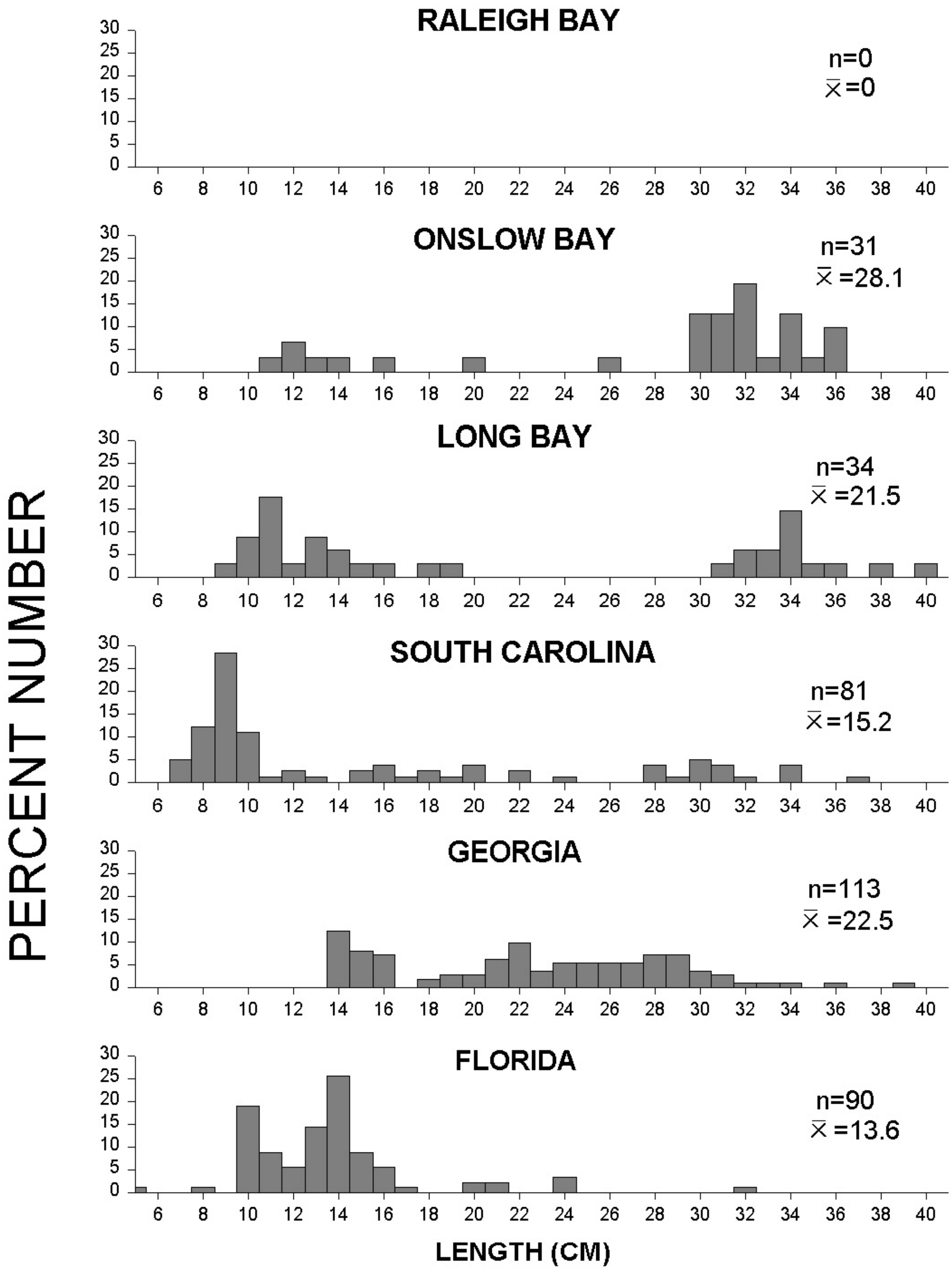

Figure 17. Regional length-frequencies of *Scomberomorus cavalla* from inner strata in 1999.

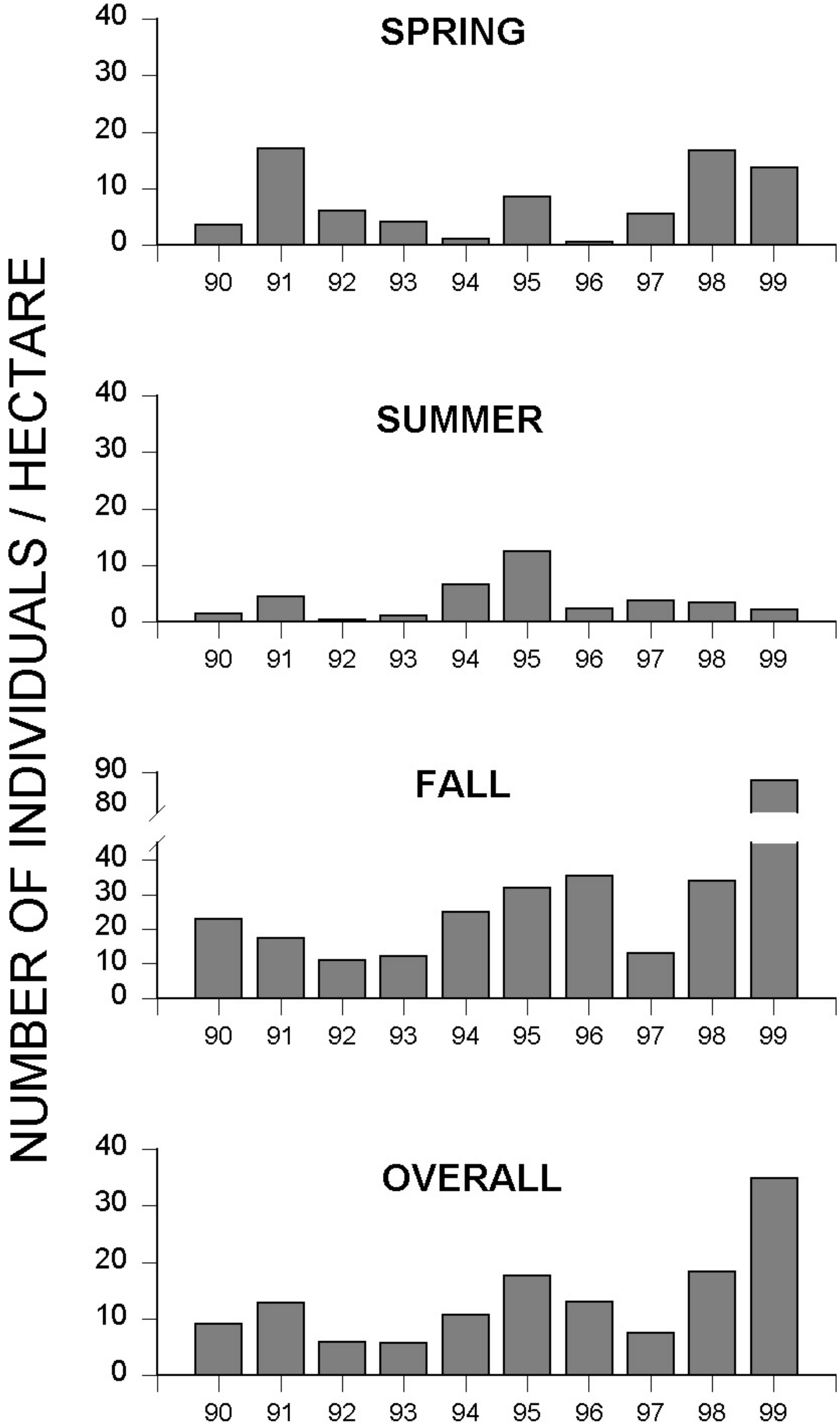

Figure 18. Annual densities of *Litopenaeus setiferus* from inner strata.

Table 4. Estimates of density (number of individuals/hectare) for three commercially important penaeid species among regions and seasons for 1999.

Litopenaeus setiferus

	Spring	Summer	Fall	Region
Raleigh Bay	1.5	0.0	108.4	35.7
Onslow Bay	4.0	1.7	49.8	18.1
Long Bay	0.0	0.9	110.4	37.0
South Carolina	29.7	3.9	117.4	51.8
Georgia	15.4	0.2	89.1	35.5
Florida	13.3	4.0	8.3	8.5
Season	13.6	2.1	87.7	34.8

Farfantepenaeus aztecus

	Spring	Summer	Fall	Region
Raleigh Bay	0.0	0.0	10.4	3.4
Onslow Bay	0.05	16.1	6.4	7.4
Long Bay	0.0	4.3	1.8	2.0
South Carolina	0.0	11.5	0.6	4.0
Georgia	0.02	2.4	1.5	1.3
Florida	0.9	0.05	0.0	0.3
Season	0.1	6.7	2.2	3.0

Farfantepenaeus duorarum

	Spring	Summer	Fall	Region
Raleigh Bay	1.2	0.0	2.9	1.4
Onslow Bay	3.2	0.03	3.5	2.3
Long Bay	0.2	0.0	0.4	0.2
South Carolina	0.3	0.0	0.05	0.1
Georgia	0.2	0.0	0.03	0.07
Florida	0.03	0.0	0.0	0.01
Season	0.7	0.003	0.7	0.4

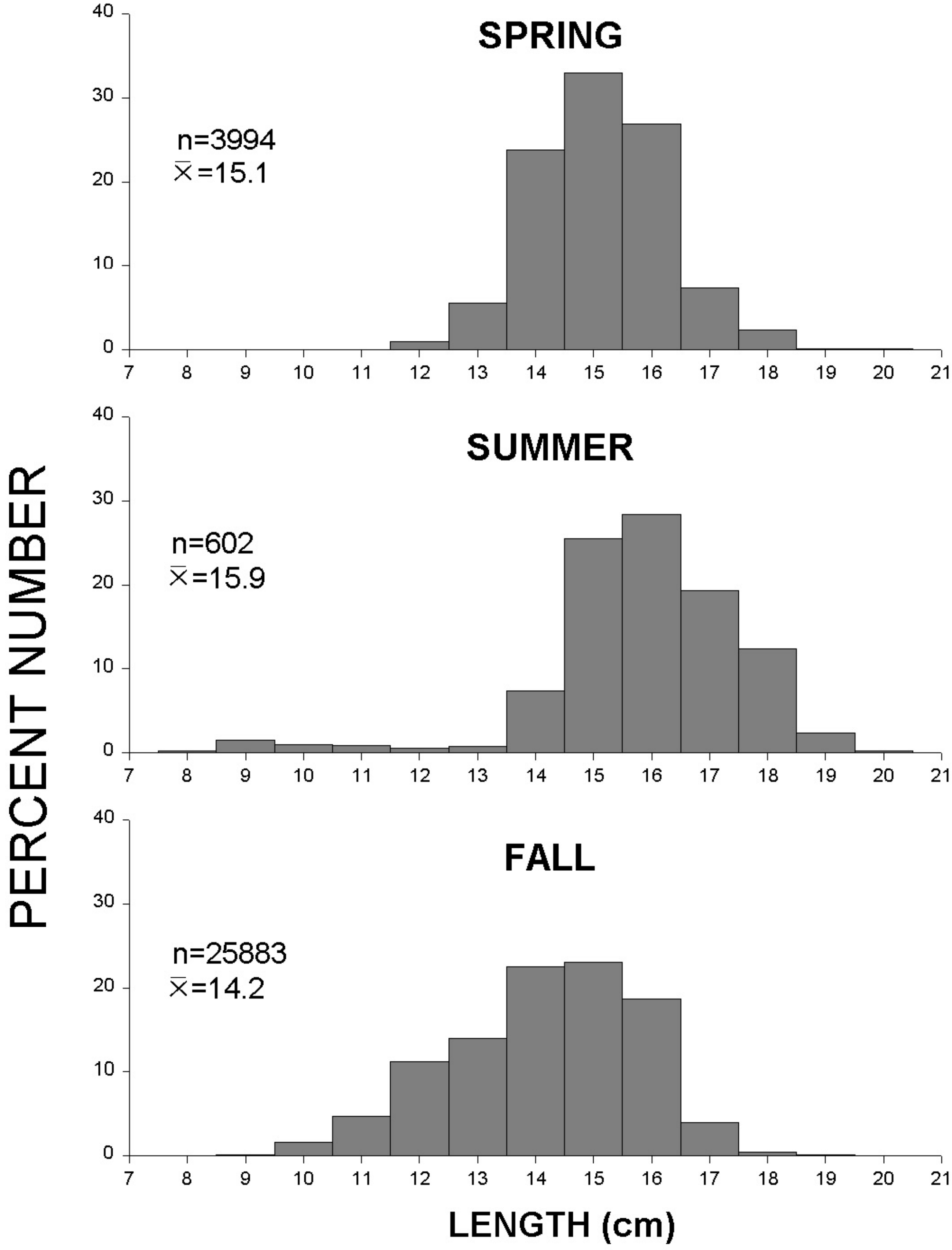

Figure 19. Seasonal length-frequencies of *Litopenaeus setiferus* from inner strata in 1999.

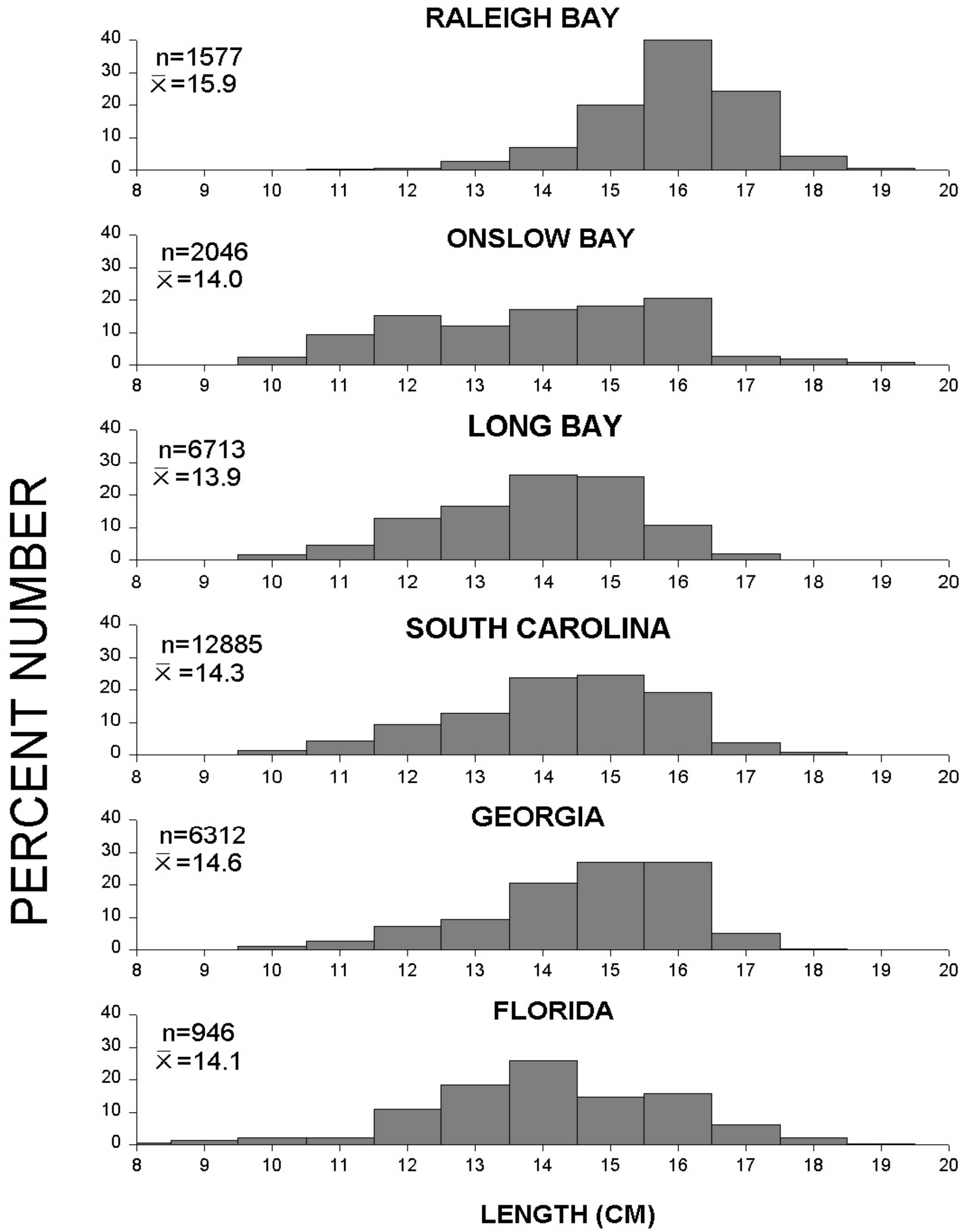

Figure 20. Regional length-frequencies of *Litopenaeus setiferus* from inner strata in 1999.

were collected (Figure 21). The ratio of males with fully developed spermatophores to those with spermatophores not yet fully developed was not independent of seasons ($G = 6036$, $p < 0.001$) or regions ($G = 1029$, $p < 0.001$). Only 4% of females collected in inner strata had ripe ovaries. The ratio of ripe to nonripe females was not independent of season ($G = 2996$, $p < 0.001$) or region ($G = 464$, $p < 0.001$). The percentage of ripe females was virtually the same spring (32%) and summer (33%) and dropped to zero in fall when 88% of the females were taken. Less than 2% of the females taken in spring or summer were mated. Only one mated female was collected from outer strata. However, this one animal was 1.5% of spring females, similar to inner strata.

Farfantepenaeus aztecus

Brown shrimp, formerly *Penaeus aztecus* (Perez-Farfante and Kensley, 1997), occur from Martha's Vineyard, Massachusetts, to the Florida Keys and around the Gulf of Mexico to northwestern Yucatan (Perez-Farfante, 1978; Williams, 1984). The spawning of brown shrimp is protracted and the time varies regionally, but generally occurs in fall and winter (Williams, 1984). The species supports a seasonal fishery along the mid-Atlantic states, but is most important commercially in the Gulf of Mexico off the coast of Texas (Perez-Farfante, 1978; South Atlantic Fishery Management Council, 1981; Renfro and Brusher, 1982).

The brown shrimp ranked second among penaeids in inner strata, with 2603 specimens (3.0 individuals/ha) weighing 39.1 kg (0.04 kg/ha). The density of brown shrimp individuals in 1999 was slightly higher than the low of 1998 (Figure 22). Summer collections produced the highest seasonal density (Table 4). The greatest regional density of brown shrimp occurred in Onslow Bay in summer. Collections from 1999 conform with the overall seasonal pattern of abundance of brown shrimp which includes small spring catches, followed by larger summer catches, and moderately-sized fall catches. Outer strata produced 52 brown shrimp during fall sampling.

Total lengths of *F. aztecus* ranged from 7 to 18 cm with a mean length of 11.8 cm (n =2,603). Total lengths differed significantly among seasons ($X^2 = 50.8$, $p < 0.0001$), with the mean length increasing from spring through fall (Figure 23) Lengths were also significantly different among regions ($X^2 = 29.2$, $p < 0.0001$). Mean lengths ranged from 10.1 cm in waters off Florida to 12.6 cm off Georgia (Figure 24).

The ratio of female to male brown shrimp (1:1.1) was not significantly different from unity ($X^2 = 3.0$, $p > 0.05$) in 1999. Approximately 3% of the male brown shrimp had fully developed spermatophores (ripe) and no females were found to have ripe ovaries (Figure 21). Spermatophore development was not independent of season ($G = 39.1$, $p < 0.001$) or region ($G = 13.1$ $p < 0.05$). The percentage of ripe males increased from spring (0%) to fall (9%). Mated females were collected only in fall where they constituted 7% of all females.

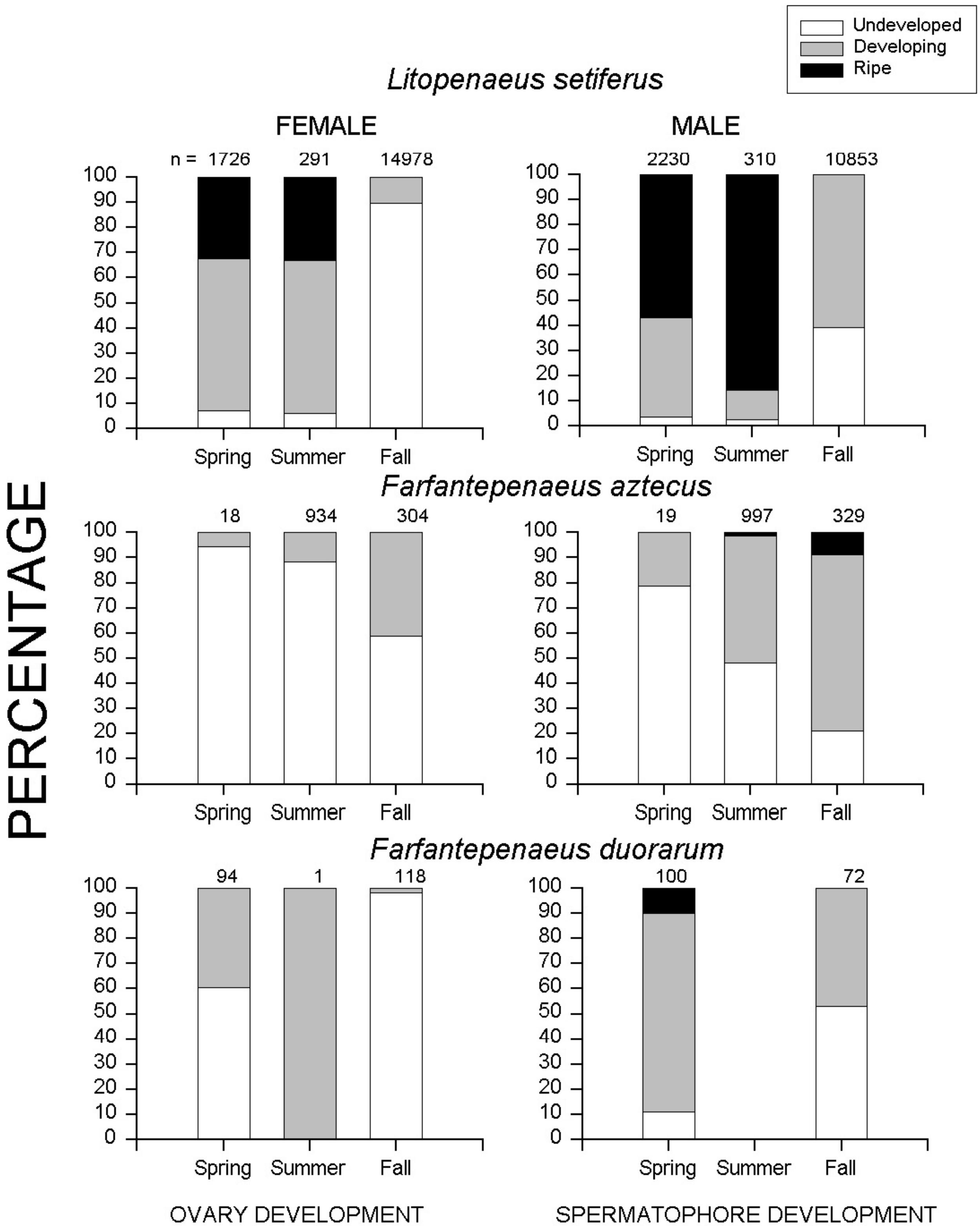

Figure 21. Gonadal development of penaeid shrimp species from inner strata in 1999.

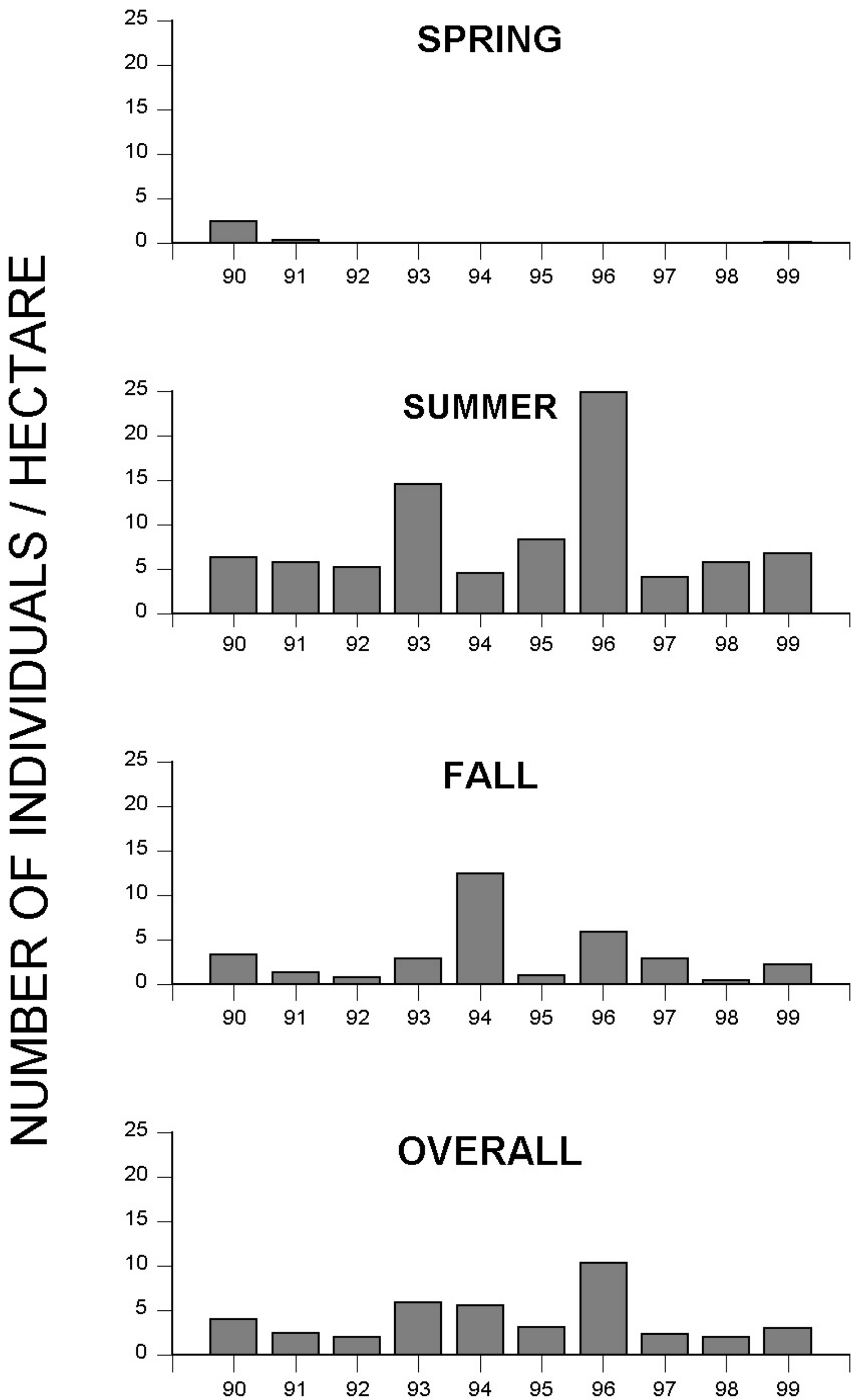

Figure 22. Annual densities of *Farfantepenaeus aztecus* from inner strata.

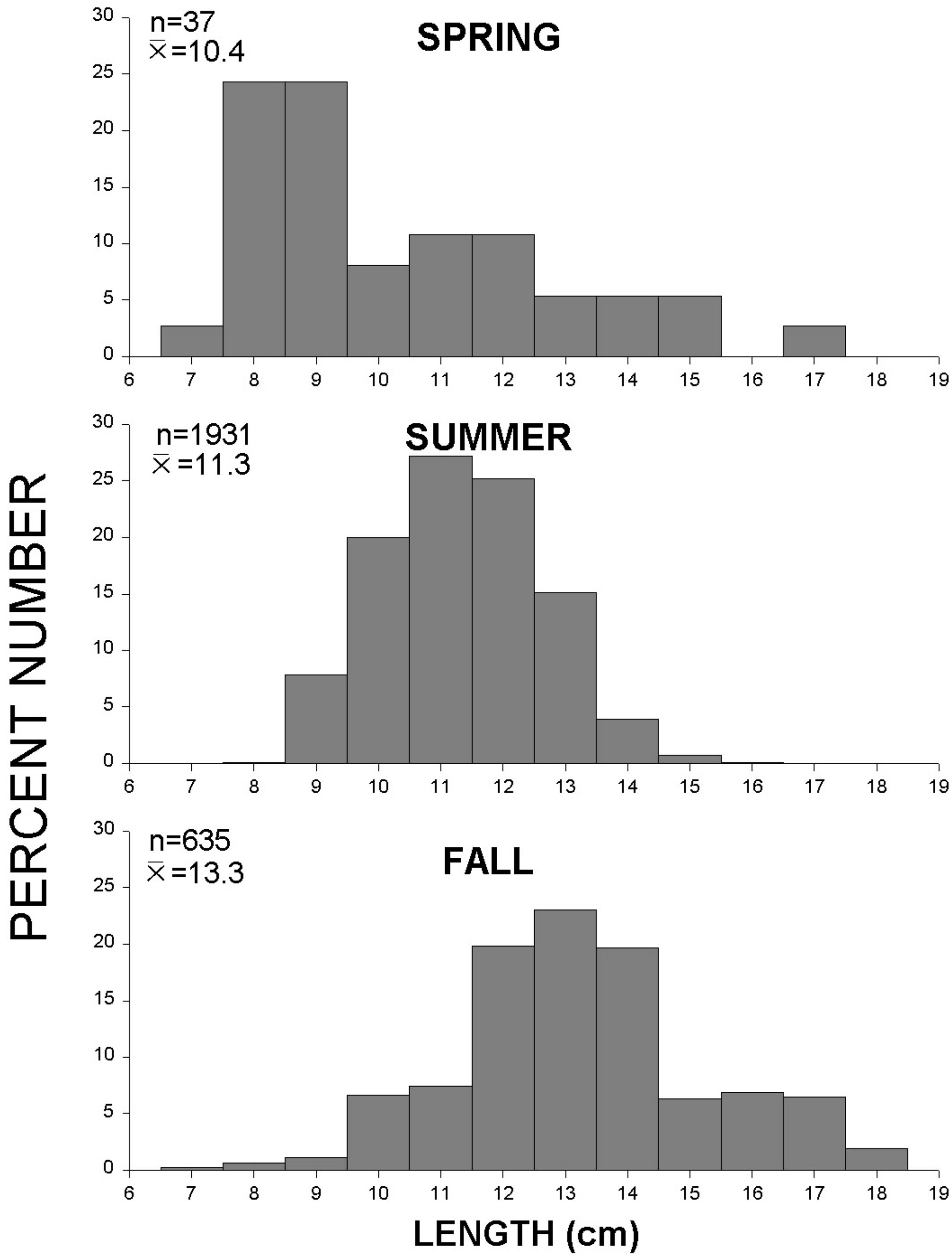

Figure 23. Seasonal length-frequencies of *Farfantepenaeus aztecus* from inner strata in 1999.

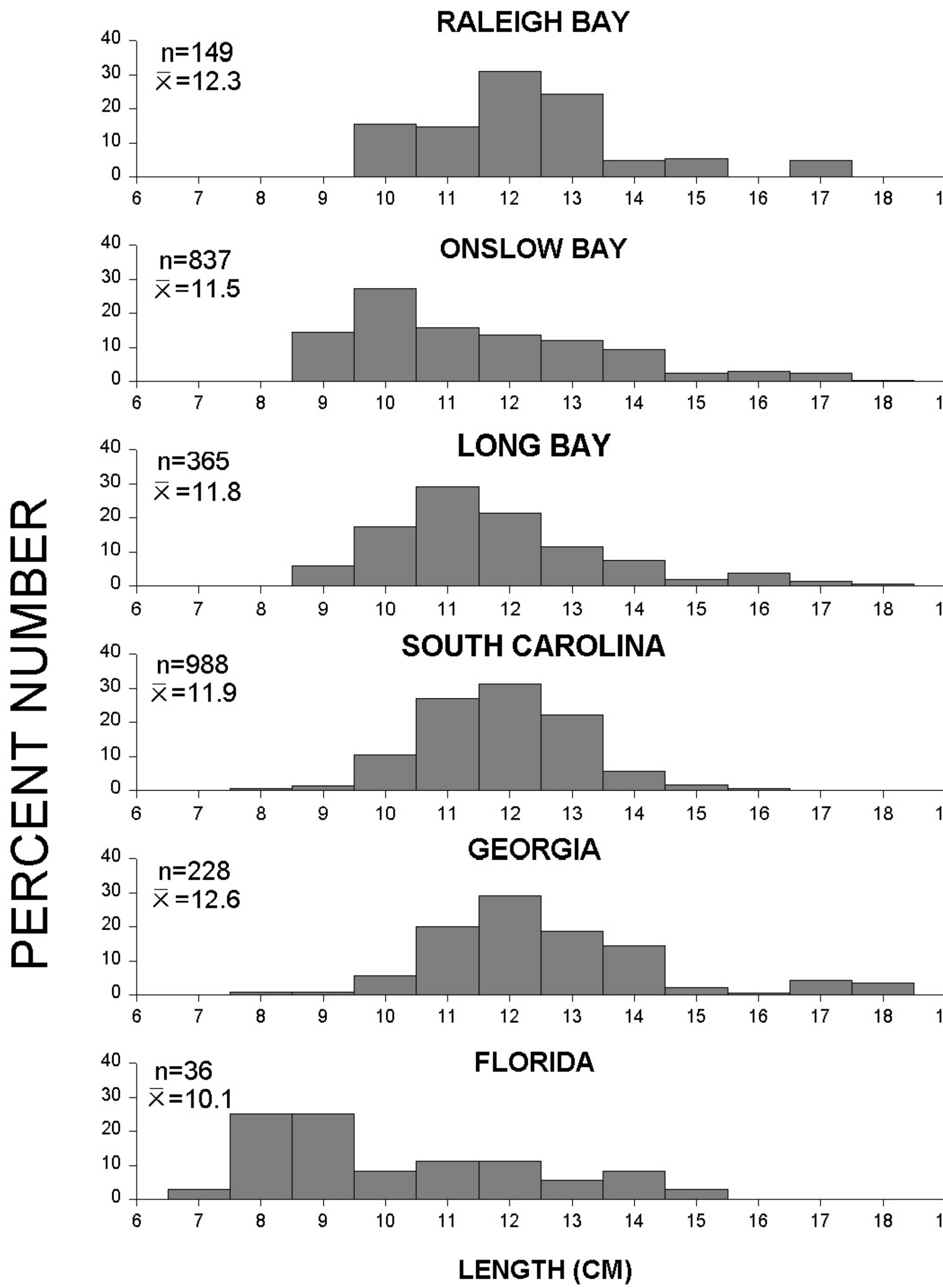

Figure 24. Regional length-frequencies of *Farfantepenaeus aztecus* from inner strata in 1999.

Farfantepenaeus duorarum

Pink shrimp, formerly *Penaeus duorarum* (Perez-Farfante and Kensley, 1997), are found from Chesapeake Bay to the Florida keys and throughout the Gulf of Mexico to the Yucatan peninsula (Perez-Farfante, 1978; Williams, 1984). They are most abundant in waters off the Gulf coast of Florida, in the Bay of Campeche, and in waters off North Carolina (Perez-Farfante, 1978; Williams, 1984).

The pink shrimp was the least abundant commercially important penaeid shrimp species collected during 1999. The 394 specimens (0.4 individuals/ha) taken from inner strata weighed 5.9 kg (0.01 kg/ha). The 1999 estimate of annual density was half that of last year and the lowest level of abundance for this species in the history of the survey (Figure 25). Greatest densities of pink shrimp were found during the spring and fall cruises in Onslow Bay (Table 4). Onslow Bay was the only region that produced pink shrimp in summer. Only 34 *F. duorarum* were taken in outer strata, roughly half from spring and half from fall.

Total length of pink shrimp ranged from 7 to 17 cm ($\bar{X}$ = 11.6 cm, n = 396). Total lengths varied significantly among seasons ($X^2 = 319$, $p < 0.0001$). Mean lengths were 12.5 cm in spring and 10.6 in fall (Figure 26). Total length did not differ significantly among regions ($X^2 = 4.0$, $p > 0.5$). Regionally, mean lengths ranged from 11.4 cm off Georgia to 12.1 cm off South Carolina (Figure 27).

The ratio of male to female pink shrimp (1:1.24) did not differ significantly from unity ($X^2 = 4.4$, $p < 0.05$) in 1999. Males with fully developed spermatophores were only collected during spring in inner strata where they comprised approximately 10% of male pink shrimp (Figure 21). Burukovskii and Bulanenkov (1971) reported that spawning activity of pink shrimp in North Carolina waters peaked in spring. Ripeness of males was not independent of season ($G = 11.2$, $p < 0.001$) or region ($G = 36.5$, $p < 0.001$). No ripe female pink shrimp were collected and only 2% of female pink shrimp sampled in spring were mated. Like brown shrimp, copulation in pink shrimp may occur regardless of developmental stage of the ovaries (Perez-Farfante, 1969).

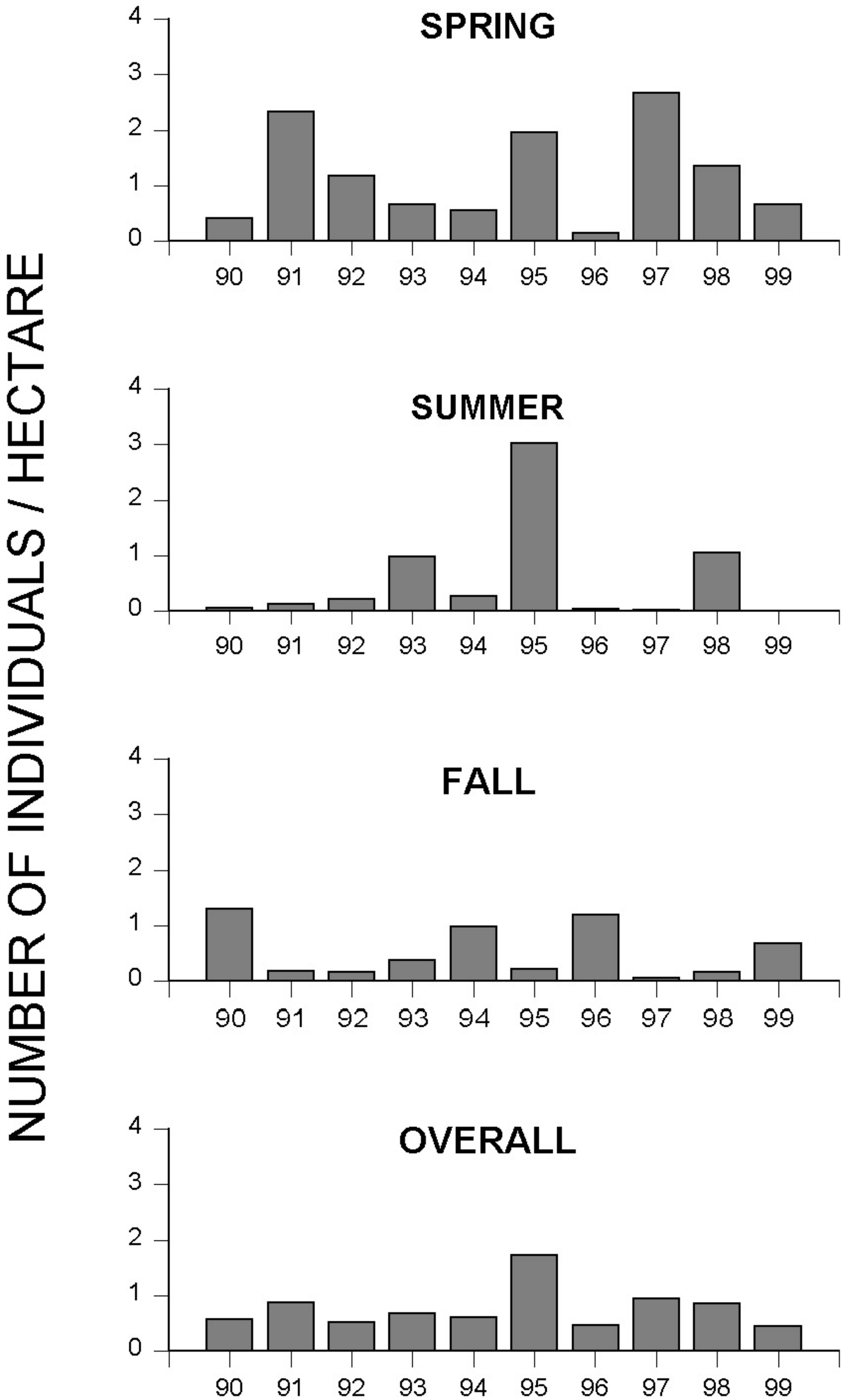

Figure 25. Annual densities of *Farfantepenaeus duorarum* from inner strata.

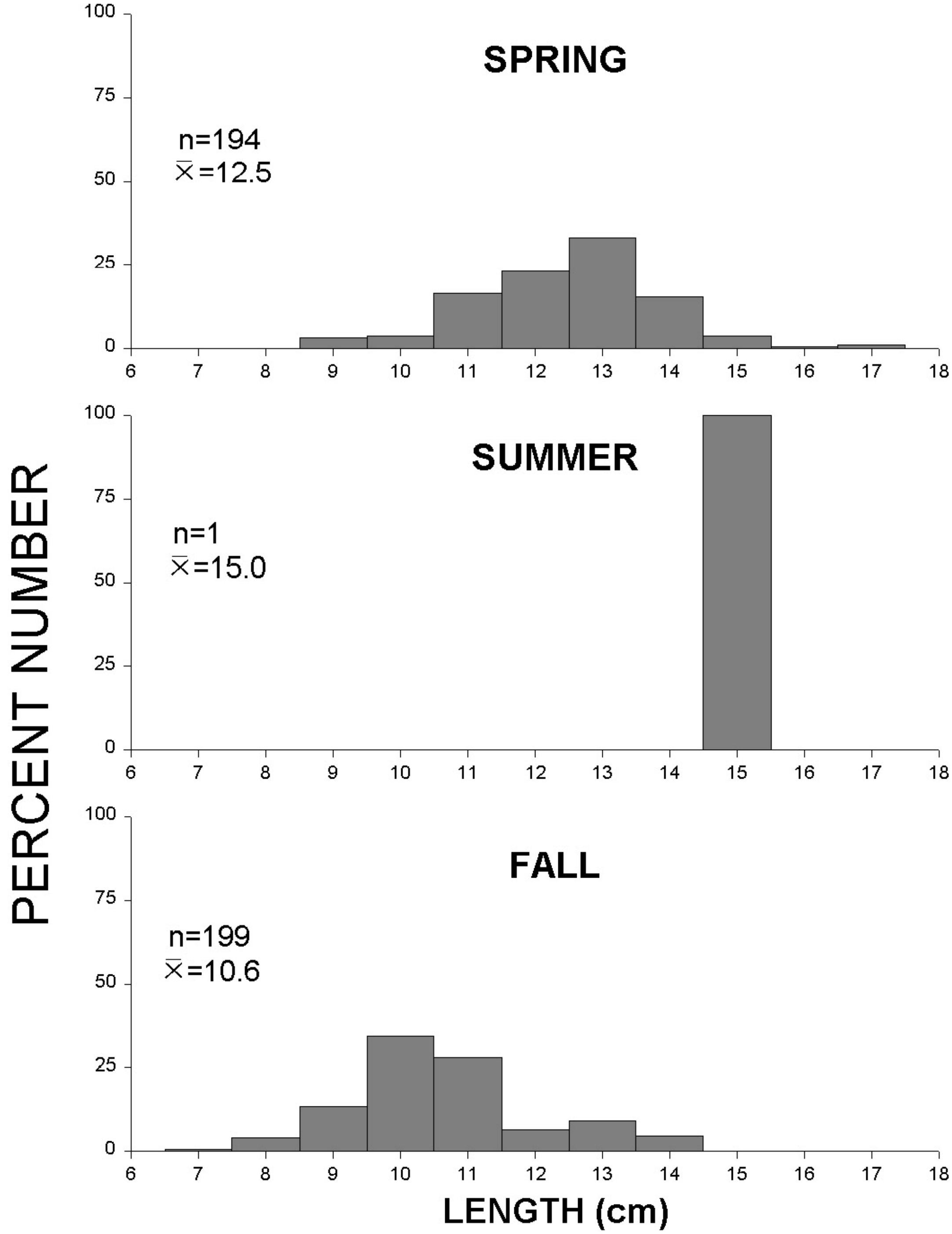

Figure 26. Seasonal length-frequencies of *Farfantepenaeus duorarum* from inner strata in 1999.

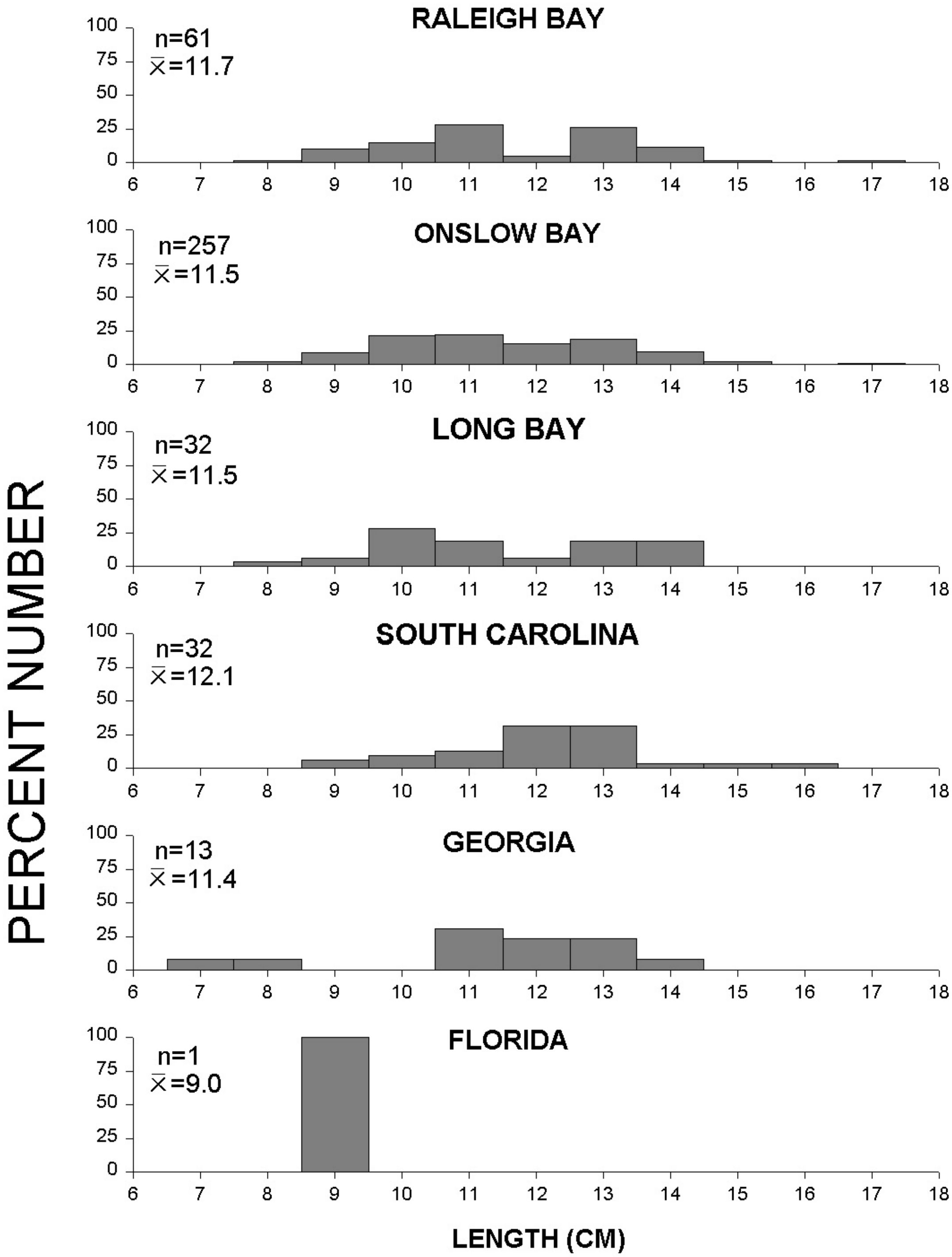

Figure 27. Regional length-frequencies of *Farfantepenaeus duorarum* from inner strata in 1999.

Distribution and Abundance of Coastal Sharks

SEAMAP-SA collected seven species of sharks in the South Atlantic Bight in 1999. The Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, was the most abundant shark collected in inner and outer strata, making up approximately 51% of the shark specimens collected in inner strata and 67% of those collected in outer strata. The smooth dogfish, *Mustelus canis,* ranked second in abundance in inner strata, followed by bonnethead shark, *Sphyrna tiburo.* The other eight species contributed less than 2% to the overall number of shark collected in inner strata. Those species include six *Carcharhinus acronotus,* four *Alopius vulpinis*, three *Carcharhinus plumbius*, two *Carcharhinus brevipinna*, two *Sphyrna lewini*, one *Odontaspis taurus*, one *Carcharhinus isodon*, and one *Squatina dumerili.* Only two species of sharks were taken in outer strata: *Rhizoprionodon terraenovae* (n=18) and *Sphyrna tiburo* (n=9).

The Atlantic sharpnose shark was the most abundant shark species collected in 1999 (n=548). The highest density was taken in summer (Table 5), when 76% of the specimens were collected. The highest density occurred in Onslow Bay and the lowest in Raleigh Bay. Outer strata produced 18 Atlantic sharpnose sharks with a little over half of the animals coming from spring collections. In spring the abundance of Atlantic sharpnose in the outer was greater than the abundance in contiguous inner strata.

Total lengths of *R. terraenovae* from 1999 SEAMAP-SA collections ranged from 27 to 100 cm for females ($\bar{x}$ = 43.5 cm, n =220) and 26 to 98 cm for males ($\bar{x}$= 53.2 cm, n =328). Lengths of both sexes differed significantly among seasons (females: $X^2 = 34.9$, $p < 0.0001$; males: $X^2 = 105.0$, $p < 0.0001$). The smallest mean lengths of Atlantic sharpnose were collected in summer for both female (spring: $\bar{x}$ = 46.3 cm, n = 10; summer: $\bar{x}$ = 42.5 cm, n = 188; fall: $\bar{x}$ = 51.3 cm, n = 22) and male (spring: $\bar{x}$ = 79.5 cm, n = 51, summer: $\bar{x}$ = 45.3 cm, n = 230; fall: $\bar{x}$ = 63.9 cm, n = 47) sharks. However, the largest mean lengths were seen in the fall for females, but in the spring for males. Total length did not vary significantly among regions for females ($X^2 = 7.0$, $p > 0.05$) or males ($X^2 = 4.1$, $p > 0.05$). Both sexes were collected in all regions and mean lengths ranged from a low of 42.6 cm off Florida to 47.5 cm in Raleigh Bay for females and low of 48.1 cm Onslow Bay to 60.1 cm off South Carolina for males.

The smooth dogfish, *Mustelus canis,* was the second most abundant shark species collected during the 1999 SEAMAP-SA survey. All 349 *M. canis* were collected in inner strata. With the exception of fall collections in Raleigh Bay, this species was collected exclusively in spring from South Carolina northward.

Table 5. Estimates of density (number of individuals/hectare) for numerically dominant coastal sharks among regions and seasons for 1999

Rhizoprionodon terraenovae

	Spring	Summer	Fall	Region
Raleigh Bay	0.0	0.3	0.2	0.2
Onslow Bay	0.1	2.6	1.1	1.2
Long Bay	0.02	2.1	0.3	0.8
South Carolina	0.4	1.5	0.03	0.6
Georgia	0.1	0.7	0.02	0.3
Florida	0.5	0.8	0.05	0.4
Season	0.2	1.5	0.2	0.6

Mustelus canis

	Spring	Summer	Fall	Region
Raleigh Bay	3.4	0.0	0.7	1.4
Onslow Bay	2.3	0.0	0.0	0.8
Long Bay	3.2	0.0	0.0	1.1
South Carolina	0.04	0.0	0.0	0.01
Georgia	0.0	0.0	0.0	0.0
Florida	0.0	0.0	0.0	0.0
Season	1.2	0.0	0.03	0.4

Sphyrna tiburo

	Spring	Summer	Fall	Region
Raleigh Bay	0.0	0.0	0.0	0.0
Onslow Bay	0.0	0.0	0.0	0.0
Long Bay	0.03	0.1	0.0	0.05
South Carolina	0.3	0.1	0.01	0.1
Georgia	0.02	0.1	0.02	0.04
Florida	1.4	1.0	0.05	0.8
Season	0.3	0.2	0.01	0.2

Total lengths of *M. canis* ranged from 33 to 117 cm for females ($\overline{X}$ = 72.3 cm, n = 187) and 53 to 102 cm for males ($\overline{X}$ = 66.3 cm, n = 162). While mean length increased from Long Bay through Raleigh Bay for both males and females in spring, regional variations in total length of male *M. canis* were found to be significant ($X^2 = 16.6$, $p < 0.001$), but those of females were not ($X^2 = 3.3$, $p > 0.05$).

The bonnethead shark, *Sphyrna tiburo,* ranked third in abundance (n=143) among sharks in 1999. Density was greatest in spring and summer (Table 5). Waters off Florida yielded the highest density in every season while no bonnethead sharks were taken in Raleigh or Onslow Bays in any season. Nine *S. tiburo* were collected in outer strata. Spring collections yielded seven of these. The two collected in fall came from Long Bay.

Total lengths of female *S. tiburo* ranged from 39 to 116 cm ($\overline{X}$ = 64.7 cm, n =51), whereas males ranged from 38 to 100 cm ($\overline{X}$ = 71.8 cm, n =92). Lengths differed significantly among seasons for males ($X^2 = 10.8$, $p < 0.005$) but not females ($X^2 = 5.5$, $p > 0.05$). Mean length was smallest in fall followed by spring and increased in summer for both females (spring: $\overline{X}$ = 61.3 cm, n = 24; summer: $\overline{X}$ = 68.5 cm, n = 25; fall: $\overline{X}$ = 58.5 cm, n = 2) and males (spring: $\overline{X}$ = 70.8 cm, n = 45; summer: $\overline{X}$ = 75.4 cm, n = 34; fall: $\overline{X}$ = 39.0 cm, n = 2). Total length varied significantly among regions for females ($X^2 = 13.8$, $p < 0.005$) and males ($X^2 = 30.9$, $p < 0.0001$). Greatest mean length of males occurred in Long Bay and females off South Carolina. Smallest mean length in males occurred off Florida, while Georgia yielded the smallest mean length for females.

SEAMAP-SA DATA AND SPECIMENS DISTRIBUTED IN 1999

Specimens:

Specimens of *Leiostomus xanthurus, Micropogonias undulatus, Cynoscion regalis, Cynoscion nebulosus*, and *Menticirrhus americanus* for verification of age-at-length key for use in other monitoring efforts (SCDNR/MRRI)

Fin tissue samples of *Cynoscion regalis* and blood samples of *Limulus polyphemus* for DNA analysis (SCDNR/MRRI)

Penaeid shrimp samples: haemolymph, gill, and head for viral testing (SK , SCDNR)

Specimens of *Centropristis striata* and *Lutjanus campechanus* for life history study (MARMAP, SCDNR/MRRI)

Specimens of *Etropus crossotus*, *Etropus cyclosquamus*, *Citharicthys macrops*, *Citharicthys spilopterus*, and *Syacium papilosum* for fecundity/life history research (University of South Carolina)

Specimens of menhaden (*Brevoortia tyrannus*) and croaker (*Micropogonias undulatus*) with lesions (SCDNR/MRRI)

Representative specimens of finfish species for zooarcheological reference collection and specimens of *Bagre marinus* and *Arius felis* for graduate student research (University of Tennessee, Knoxville)

Pomatomus saltatrix specimens for age-growth and genetics studies (SUNY Stoney Brook)

Specimens of *Scomberomorus maculatus* above legal size from South Carolina coastal waters were provided for heavy metal contaminants screening (SCDHEC)

Specimens of *Litopenaeus setiferus* and *Farfantepenaeus aztecus* for marine forensics standards (NOAA/NOS/SEFC)

Data:

Reformatted weakfish and Atlantic menhaden abundance and length-frequency data for VPA (Doug Vaughn, NMFS, Beaufort, NC)

All catch data from the Cape Romaine, SC area (1990-1999) to feed into a data base for the Cape Romaine Wildlife Refuge to assist with refuge management efforts (NOAA student intern)

All catch data (1989-1999) from stations near Cape Canaveral National Seashore, FL were provided to the park to improve their data base of park fauna (National Park Service)

Menticirrhus americanus, *M. littoralis*, and *M. saxatilis* abundance and biomass data (1990-1999) from catches off Georgia (GADNR)

All SEAMAP-SA data 1990-1999 for graduate thesis work (University of Charleston, SC)

Abundance and capture location data from 1990 - 1999 for *Bagre marinus* and all *Portunus* species were provided to Florida Marine Patrol for use in litigation

ACKNOWLEDGMENTS

We appreciate the administrative assistance of David Cupka, David Whitaker, and Wayne Waltz and the recommendations of the SEAMAP-SA Committee. The dedication of captains Mike Schwarz and Jeff Jacobs helped realize the successful completion of SEAMAP-SA cruises through their able operation of the R/V *Lady Lisa*. Jonathan Kelsey, Casey Rhodes, Dawn Sagonias, Richard Seals, and Rebecca Zackrison assisted with field efforts.

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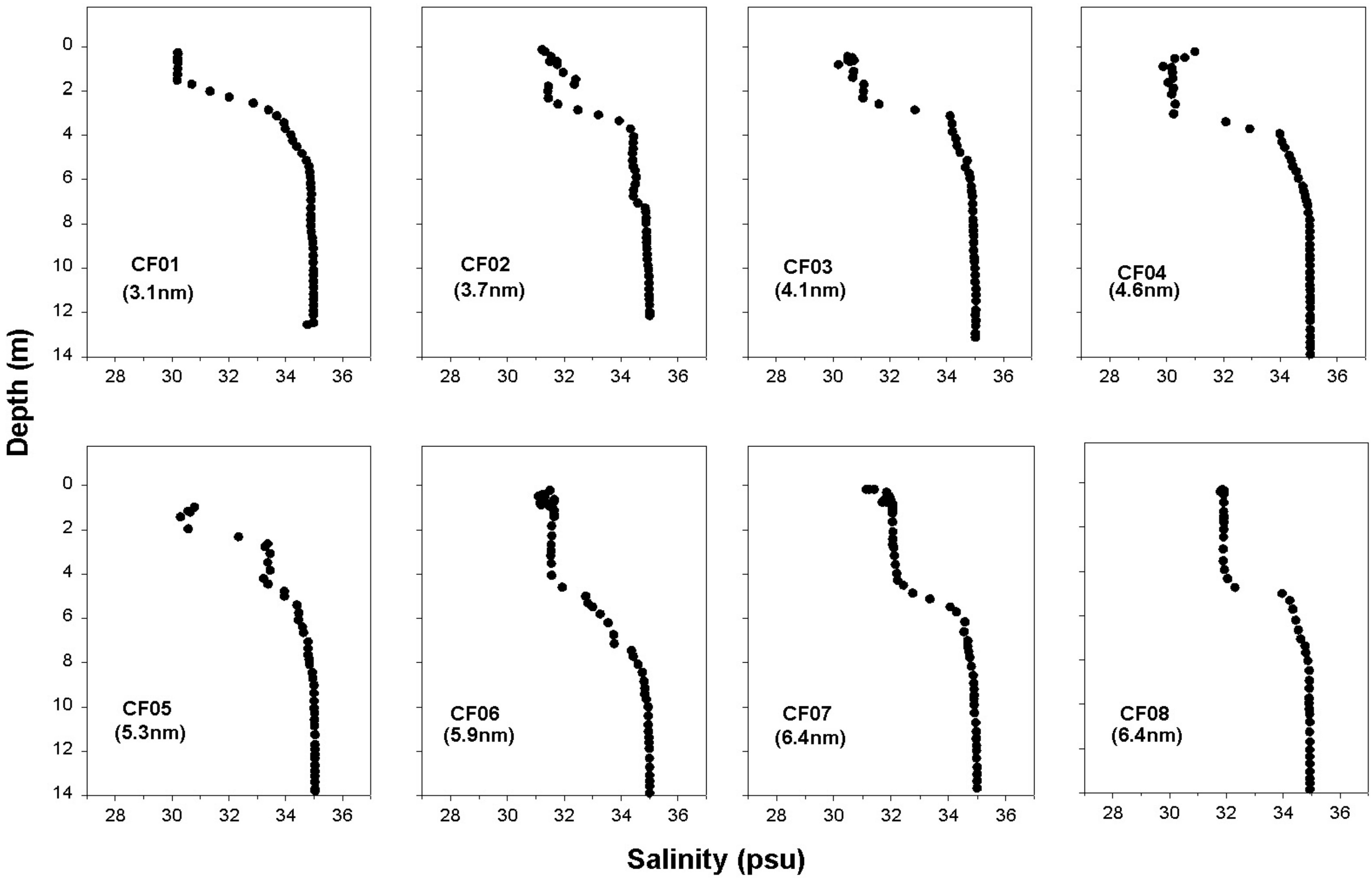
Appendix 1. Size statistics of target species from all 1999 SEAMAP-SA collections.

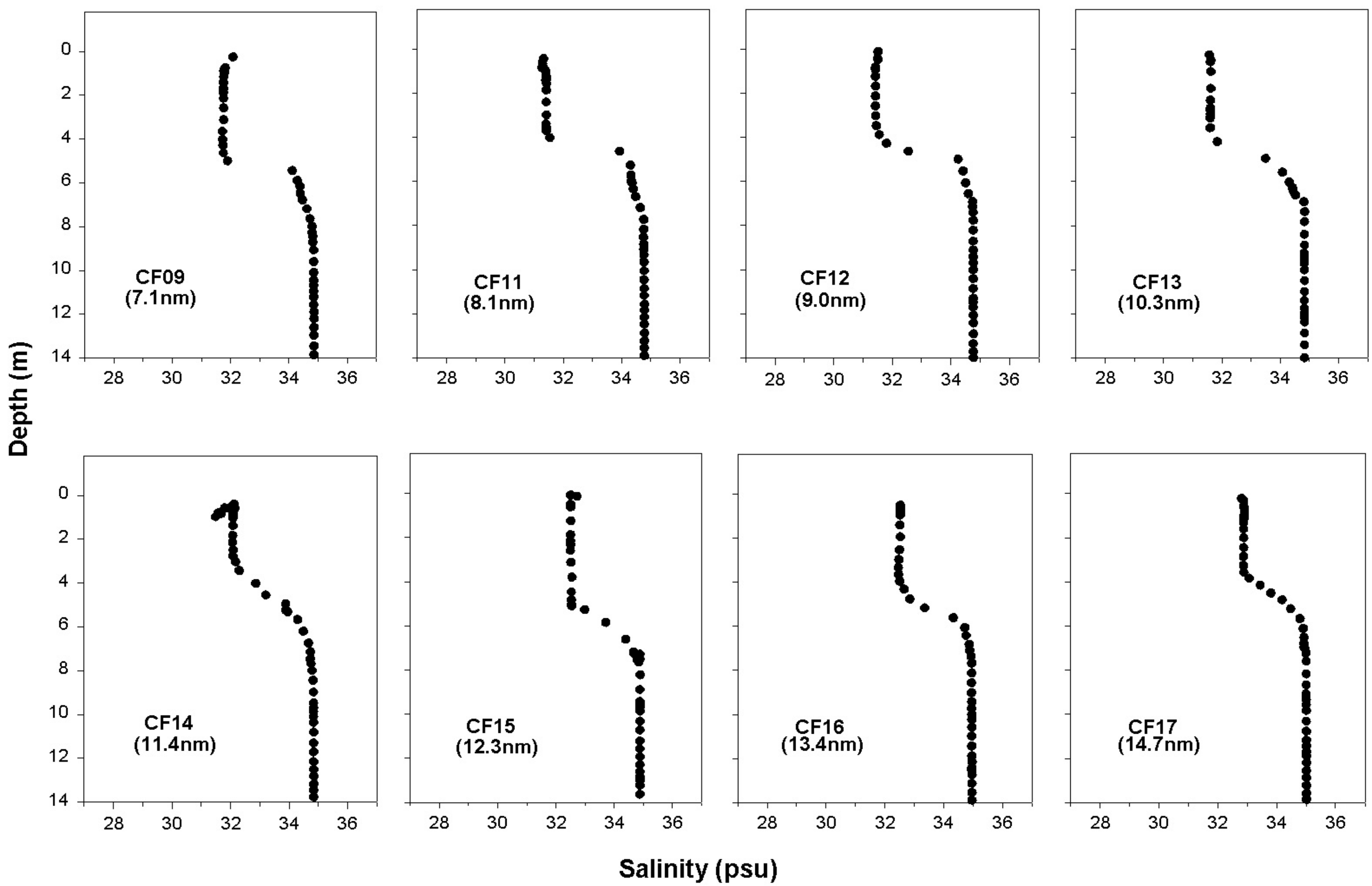
FINFISH	MEAN LENGTH (CM)	SIZE EXTREMES (CM)
Archosargus probatocephalus	39.5	26-53
Brevoortia smithi	23.7	19-30
B. tyrannus	17.1	11-28
Centropristis striata	16.7	9-30
Chaetodipterus faber	9.2	4-25
Cynoscion nebulosus	26.5	26-27
C. regalis	19.1	6-38
Leiostomus xanthurus	14.7	7-25
Menticirrhus americanus	21.0	5-37
M. littoralis	23.6	10-39
M. saxatilis	23.3	10-31
Micropogonias undulatus	16.9	8-26
Mycteroperca microlepis	*	N/A
Paralichthys albigutta	25.3	16-41
P. dentatus	25.1	15-39
P. lethostigma	28.6	16-49
Peprilus alepidotus	10.2	3-19
P. triacanthus	12.2	2-19
Pogonias cromis	21.7	16-54
Pomatomus saltatrix	18.8	10-34
Sciaenops ocellata	105	102-108
Scomberomorus cavalla	19.5	5-40
S. maculatus	21.1	3-45
DECAPOD CRUSTACEANS		
Farfantepenaeus aztecus	11.9	7-18
F. duorarum	11.6	7-17
Litopenaeus setiferus	14.3	8-20
Callinectes sapidus	14.6	6-19

* No specimens of *Mycteroperca microlepis* were collected.

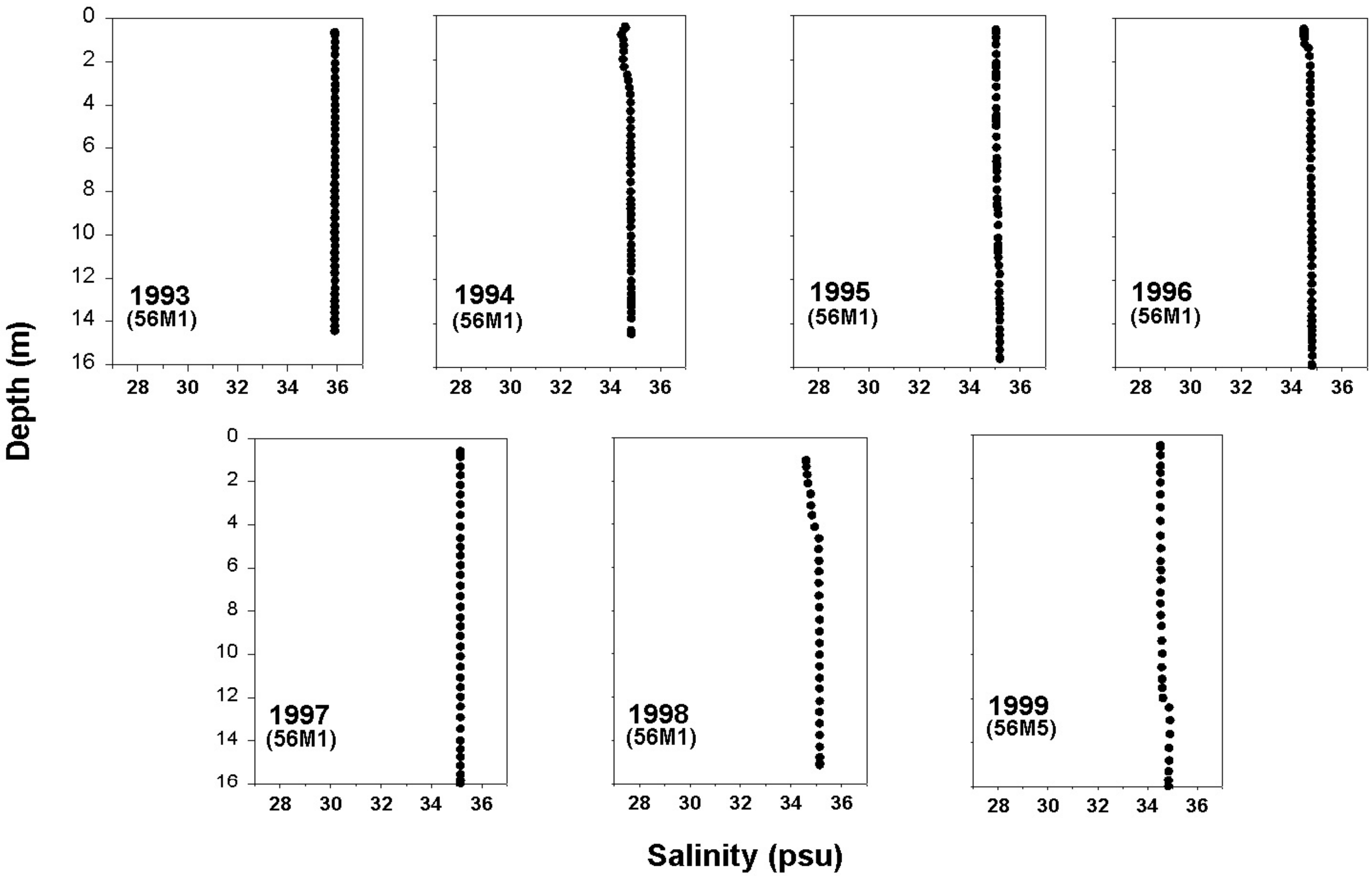
Appendix 2. Cape Fear River Transect at 230 degrees magnetic from the abandoned light tower on Bald Head Is.
October 5, 1999
(approximate distance in nautical miles from light tower to station in parentheses)



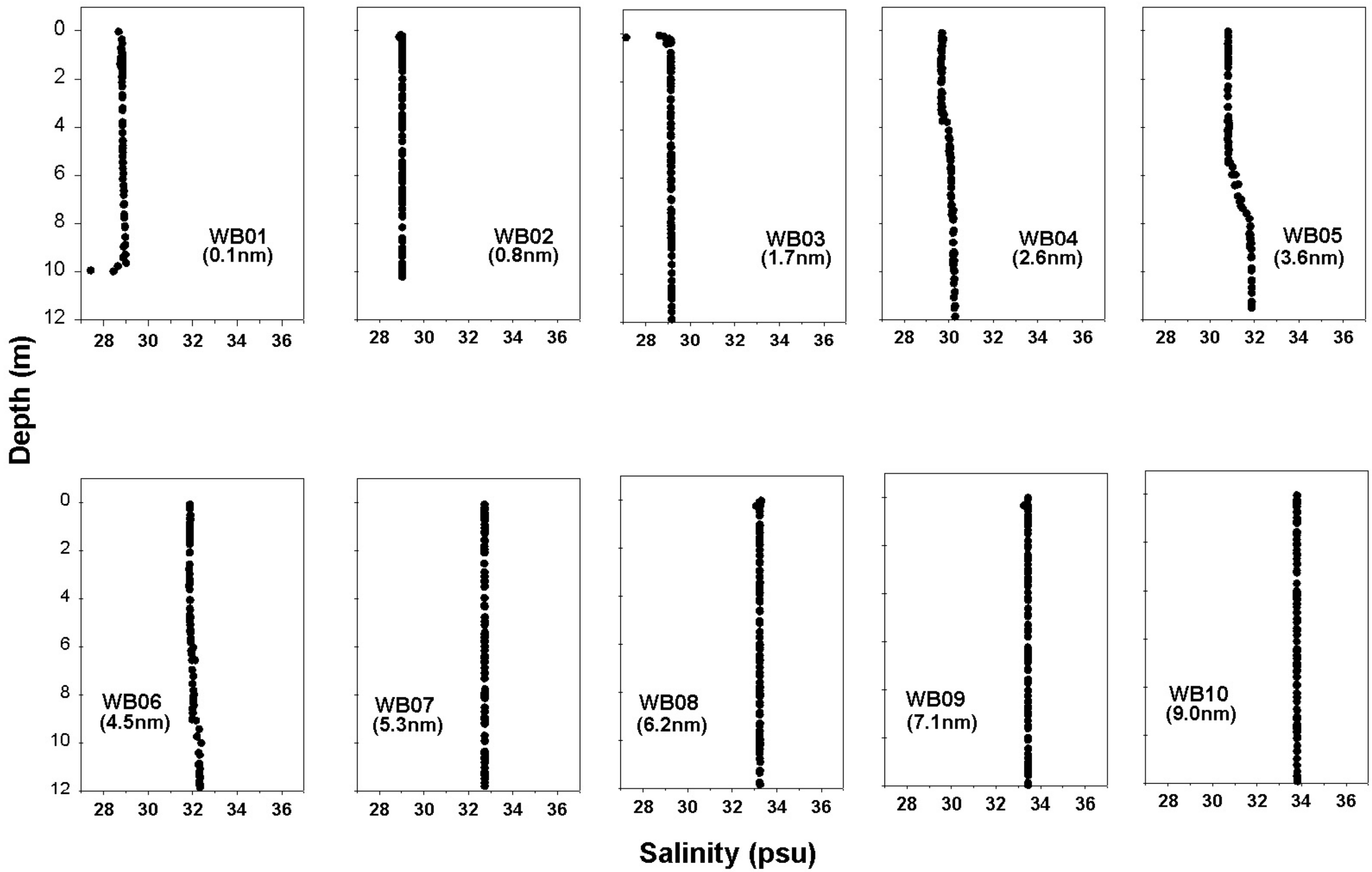
Cape Fear River Transect at 230 degrees magnetic from the abandoned light tower on Bald Head Is.
October 5, 1999
(approximate distance in nautical miles from light tower to station in parentheses)



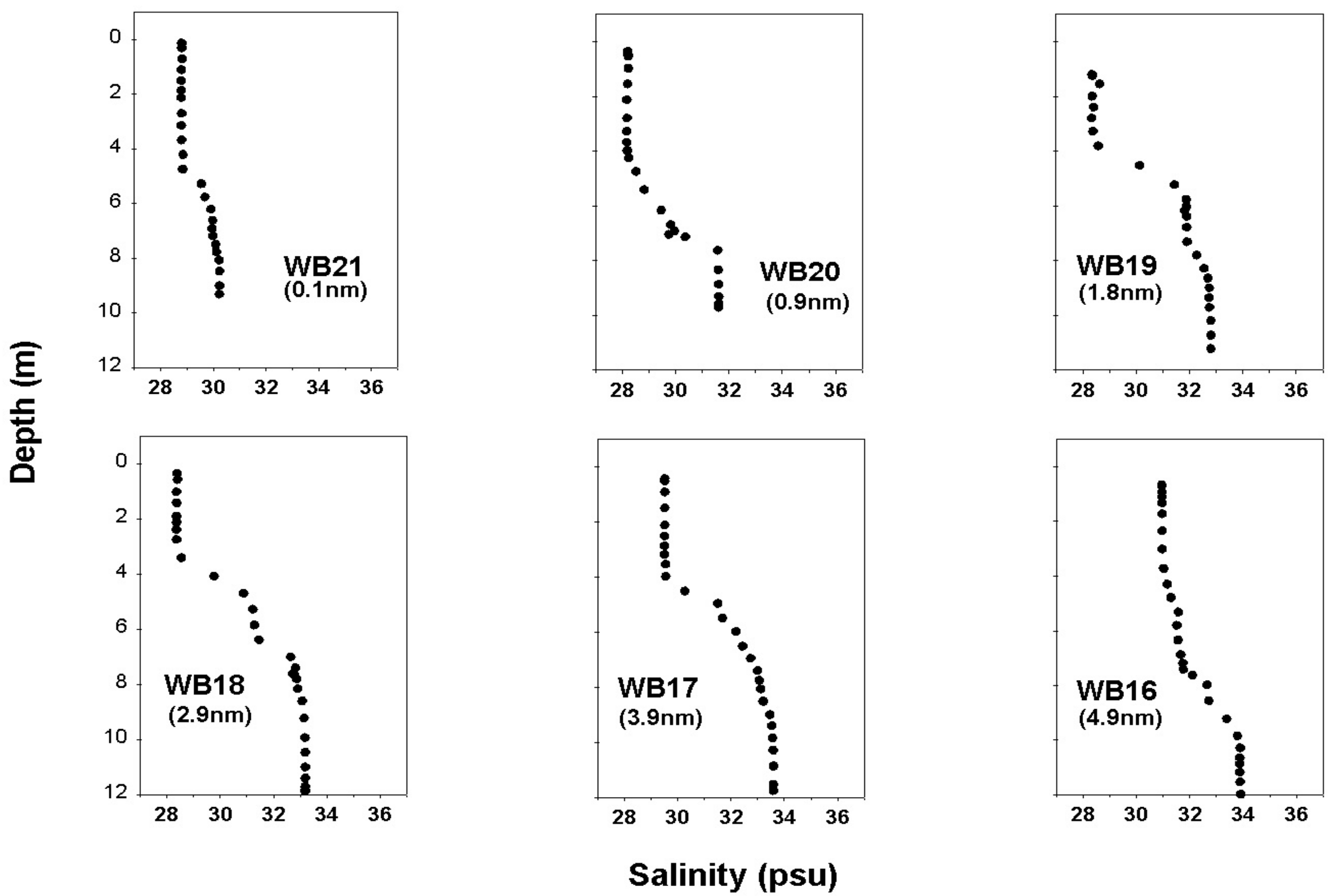
Historical data from Fall stations within approximately two nautical miles of CF13 and CF14
(Station code in parentheses)



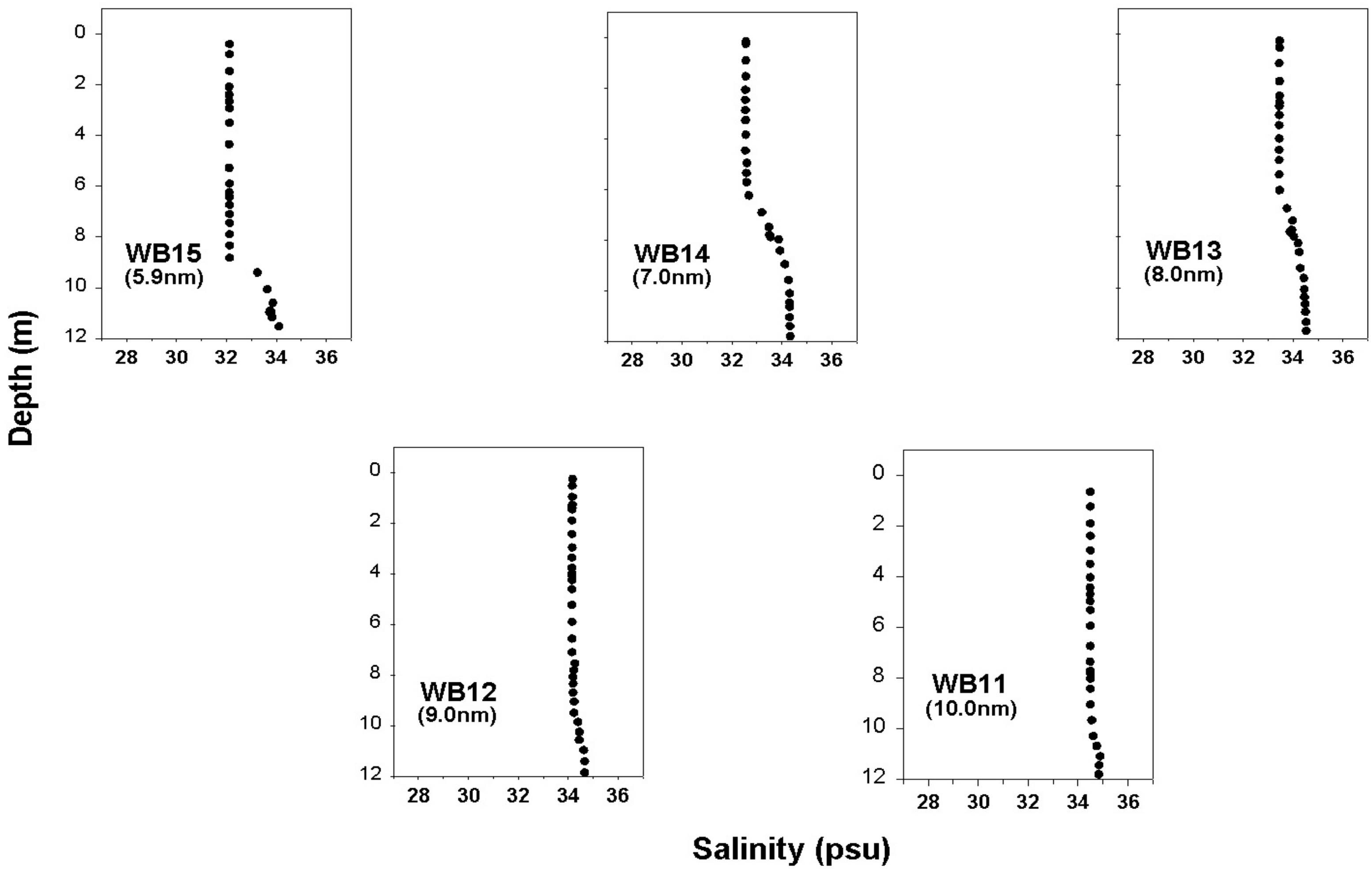
Winyah Bay Transect at 095 degrees magnetic from the Winyah Bay Jetties
October 7, 1999
(approximate distance in nautical miles from the jetties in parentheses)



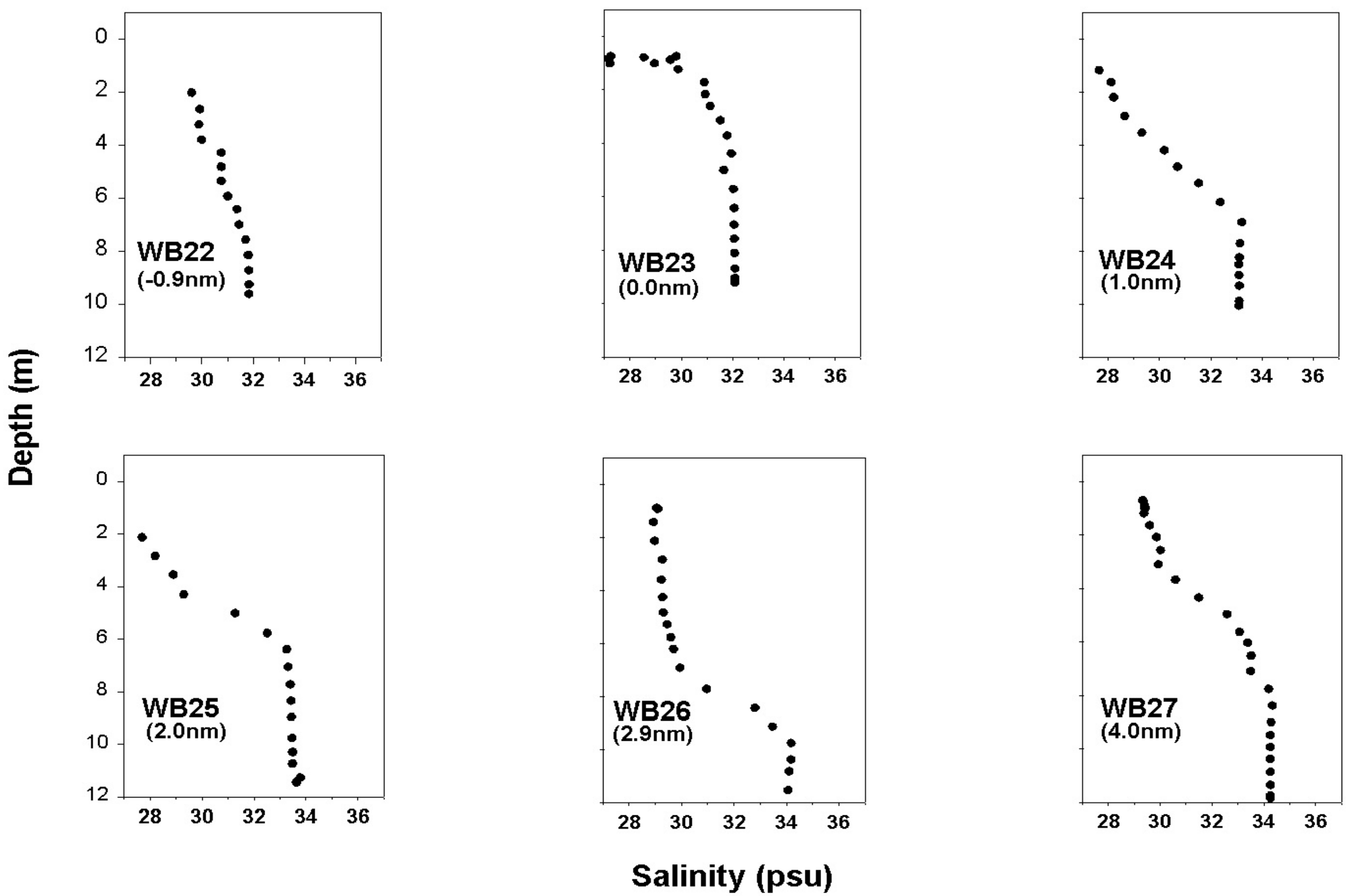
Winyah Bay Transect at 095 degrees magnetic from the Winyah Bay Jetties
October 15, 1999
(approximate distance in nautical miles from the jetties in parentheses)



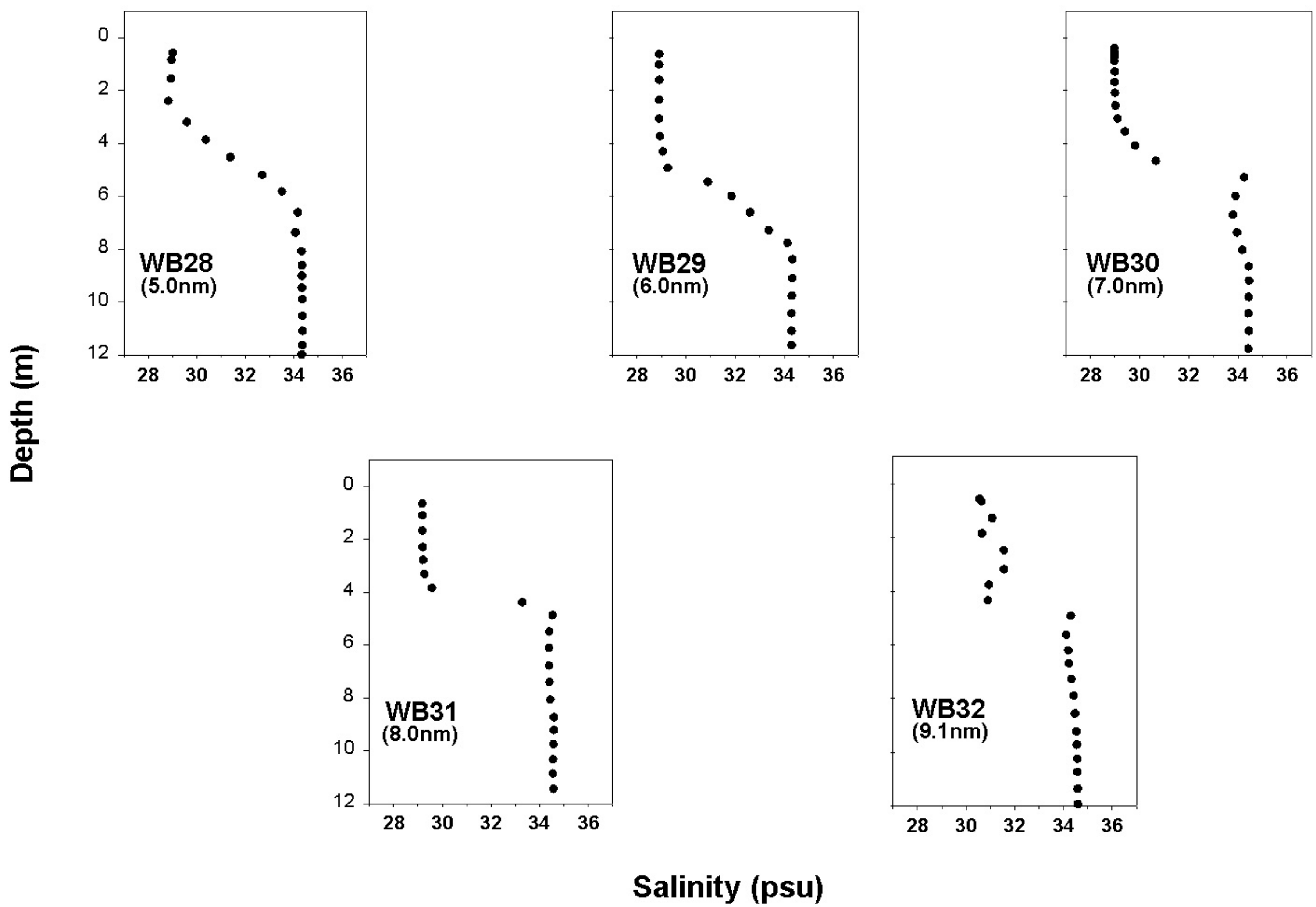
Winyah Bay Transect at 095 degrees magnetic from the Winyah Bay Jetties
October 15, 1999
(approximate distance in nautical miles from the jetties in parentheses)



Winyah Bay Transect at 095 degrees magnetic from the Winyah Bay Jetties
November 7, 1999
(approximate distance in nautical miles from the jetties in parentheses)



Winyah Bay Transect at 095 degrees magnetic from the Winyah Bay Jetties
November 7, 1999
(approximate distance in nautical miles from the jetties in parentheses)



Appendix 3. Number of individuals and biomass (kg) for all species collected in 1999. Abundance and biomass for inner strata only are indicated in parentheses.

RANK	SPECIES	TOTAL NUMBER		TOTAL WEIGHT	
1	MICROPOGONIAS UNDULATUS	57200	(51726)	3206.485	(2597.329)
2	LITOPENAEUS SETIFERUS	30640	(30479)	719.633	(714.682)
3	LEIOSTOMUS XANTHURUS	22239	(18538)	1189.647	(875.621)
4	CHLOROSCOMBRUS CHRYSURUS	22044	(19208)	465.074	(377.033)
5	STENOTOMUS SP.	20051	(3129)	856.917	(152.906)
6	STELLIFER LANCEOLATUS	16984	(16949)	213.733	(212.660)
7	LAGODON RHOMBOIDES	15903	(13900)	786.988	(644.370)
8	ANCHOA HEPSETUS	15001	(14797)	140.195	(138.540)
9	SELENE SETAPINNIS	10371	(10273)	105.530	(102.321)
10	LOLLIGUNCULA BREVIS	9755	(9689)	101.292	(100.329)
11	MENTICIRRHUS AMERICANUS	8085	(6981)	927.940	(737.206)
12	CYNOSCION NOTHUS	7119	(6722)	202.183	(167.859)
13	LIBINIA DUBIA	6631	(6624)	71.356	(71.283)
14	OPISTHONEMA OGLINUM	6559	(6195)	123.566	(108.693)
15	SYNODUS FOETENS	6314	(3060)	434.428	(185.318)
16	PRIONOTUS CAROLINUS	5752	(4993)	76.463	(63.121)
17	LOLIGO SP.	5704	(2834)	75.538	(38.955)
18	PORTUNUS GIBBESII	5467	(5369)	30.705	(29.639)
19	LARIMUS FASCIATUS	5338	(4962)	283.202	(250.297)
20	PEPRILUS TRIACANTHUS	5157	(3485)	311.117	(136.574)
21	ANCHOA MITCHILLI	4928	(4923)	7.213	(7.191)
22	CALLINECTES SIMILIS	4636	(4548)	51.388	(49.562)
23	XIPHOPENAEUS KROYERI	4600	(4600)	25.925	(25.925)
24	CYNOSCION REGALIS	4439	(3841)	287.270	(228.000)
25	TRICHIURUS LEPTURUS	3969	(3947)	82.241	(81.395)
26	ORTHOPRISTIS CHRYSOPTERA	3477	(1618)	211.293	(71.038)
27	PEPRILUS PARU	2796	(2775)	122.060	(120.904)
28	FARFANTEPENAEUS AZTECUS	2655	(2603)	40.677	(39.060)
29	OVALIPES STEPHENSONI	2454	(1378)	27.734	(13.124)
30	TRINECTES MACULATUS	1553	(1529)	50.849	(50.362)
31	CHAETODIPTERUS FABER	1521	(1347)	95.592	(90.175)
32	ANCHOA LYOLEPIS	1446	(1408)	1.912	(1.870)
33	SCOMBEROMORUS MACULATUS	1296	(1275)	136.774	(133.204)
34	BAIRDIELLA CHRYSOURA	1223	(1222)	48.379	(48.330)
35	POMATOMUS SALTATRIX	1038	(1028)	95.461	(92.499)
36	SQUILLA EMPUSA	1023	(979)	15.966	(15.104)
37	SYMPHURUS PLAGIUSA	1016	(959)	34.300	(32.358)
38	PORTUNUS SPINIMANUS	809	(760)	9.841	(8.971)

RANK	SPECIES	TOTAL NUMBER		TOTAL WEIGHT	
39	CALLINECTES SAPIDUS	795	(786)	117.133	(116.086)
40	DECAPTERUS PUNCTATUS	774	(316)	31.754	(18.059)
41	RAJA EGLANTERIA	767	(663)	740.463	(591.362)
42	SELENE VOMER	743	(743)	30.845	(30.845)
43	UROPHYCIS REGIUS	737	(734)	24.370	(24.294)
44	CARANX CRYSOS	733	(523)	64.758	(44.781)
45	ARENAEUS CRIBRARIUS	715	(714)	26.476	(26.465)
46	PRIONOTUS SCITULUS	713	(401)	20.023	(9.405)
47	SQUILLA NEGLECTA	649	(643)	6.794	(6.691)
48	ETROPUS CROSSOTUS	630	(460)	13.917	(9.623)
49	OVALIPES OCELLATUS	628	(609)	11.804	(11.576)
50	RHIZOPRIONODON TERRAENOVAE	566	(548)	447.663	(379.323)
51	CITHARICHTHYS MACROPS	543	(463)	11.186	(9.500)
52	ANCYLOPSETTA QUADROCELLATA	518	(411)	29.573	(21.612)
53	SPHYRAENA GUACHANCHO	504	(394)	23.399	(14.061)
54	EUCINOSTOMUS SP.	460	(333)	6.230	(3.919)
55	FARFANTEPENAEUS DUORARUM	428	(394)	6.458	(5.865)
56	SCOMBEROMORUS CAVALLA	381	(349)	36.578	(31.553)
57	RIMAPENAEUS CONSTRICTUS	377	(371)	0.946	(0.920)
58	BREVOORTIA TYRANNUS	373	(373)	31.235	(31.235)
59	MUSTELUS CANIS	349	(349)	398.834	(398.834)
60	DIPLECTRUM FORMOSUM	347	(17)	17.147	(1.262)
61	DASYATIS SAYI	325	(285)	687.861	(581.361)
62	HARENGULA JAGUANA	322	(321)	5.878	(5.856)
63	SARDINELLA AURITA	308	(256)	3.648	(2.190)
64	PARALICHTHYS DENTATUS	254	(233)	44.698	(39.319)
65	SCOPHTHALMUS AQUOSUS	232	(213)	10.046	(9.016)
66	GYMNURA MICRURA	218	(218)	165.227	(165.227)
67	PRIONOTUS EVOLANS	215	(200)	7.442	(6.181)
68	SPHOEROIDES MACULATUS	212	(154)	14.919	(12.073)
69	MYLIOBATIS FREMINVILLEI	191	(191)	522.358	(522.358)
70	CHILOMYCTERUS SCHOEPFI	191	(173)	42.437	(36.829)
71	RHINOPTERA BONASUS	186	(186)	815.982	(815.982)
72	LIBINIA EMARGINATA	181	(153)	3.458	(3.144)
73	MENTICIRRHUS LITTORALIS	159	(159)	23.840	(23.840)
74	SPHYRNA TIBURO	152	(143)	251.962	(235.667)
75	SYACIUM PAPILLOSUM	143	(16)	10.921	(1.252)
76	PRIONOTUS SALMONICOLOR	138	(70)	8.065	(1.644)
77	BAGRE MARINUS	134	(134)	8.235	(8.235)
78	PAGURUS POLLICARIS	132	(129)	3.375	(3.335)
79	DASYATIS SABINA	109	(109)	23.142	(23.142)
80	CENTROPRISTIS STRIATA	98	(86)	8.346	(7.070)

RANK	SPECIES	TOTAL NUMBER		TOTAL WEIGHT	
81	ARIOPSIS FELIS	92	(92)	3.620	(3.620)
82	PRIONOTUS TRIBULUS	91	(83)	3.861	(2.496)
83	HEPATUS EPHELITICUS	86	(83)	2.265	(2.196)
84	ETROPUS CYCLOSQUAMUS	84	(58)	0.731	(0.530)
85	CENTROPRISTIS PHILADELPHICA	82	(45)	7.511	(4.487)
86	CALLINECTES ORNATUS	82	(82)	1.238	(1.238)
87	CITHARICHTHYS SPILOPTERUS	63	(61)	0.830	(0.801)
88	PARALICHTHYS LETHOSTIGMA	63	(59)	18.271	(17.245)
89	UMBRINA COROIDES	50	(50)	1.383	(1.383)
90	GYMNURA ALTAVELA	43	(8)	766.783	(69.980)
91	STEPHANOLEPIS HISPIDUS	43	(31)	0.349	(0.248)
92	MENTICIRRHUS SAXATILIS	41	(15)	5.559	(1.417)
93	PAGURUS LONGICARPUS	39	(39)	0.025	(0.025)
94	TRACHINOTUS CAROLINUS	37	(37)	7.964	(7.964)
95	PERSEPHONA MEDITERRANEA	36	(33)	0.444	(0.411)
96	CALAPPA FLAMMEA	36	(27)	6.820	(4.931)
97	ETRUMEUS TERES	35	(34)	0.198	(0.162)
98	PILUMNUS SAYI	34	(33)	0.144	(0.143)
99	NEOPANOPE SAYI	34	(29)	0.030	(0.026)
100	HEMIPTERONOTUS NOVACULA	33	(0)	1.401	(0.000)
101	PARALICHTHYS ALBIGUTTA	33	(18)	7.132	(1.869)
102	LAGOCEPHALUS LAEVIGATUS	31	(25)	0.901	(0.578)
103	SICYONIAB REVIROSTRIS	25	(7)	0.210	(0.056)
104	CARANX HIPPOS	24	(24)	1.014	(1.014)
105	DASYATIS AMERICANA	22	(21)	45.970	(44.190)
106	HAEMULON AUROLINEATUM	21	(5)	1.698	(0.250)
107	ACANTHOSTRACION QUADRICORNIS	20	(6)	7.417	(2.809)
108	POGONIAS CROMIS	19	(19)	5.229	(5.229)
109	ALBUNEA PARETII	17	(17)	0.073	(0.073)
110	PETROLISTHES GALATHINUS	16	(16)	0.017	(0.017)
111	UROPHYCIS FLORIDANUS	15	(12)	0.933	(0.696)
112	MOBULA HYPOSTOMA	15	(15)	111.010	(111.010)
113	MENIPPE MERCENARIA	15	(13)	1.144	(1.140)
114	RHINOBATOS LENTIGINOSUS	14	(14)	19.201	(19.201)
115	ECHENEIS NAUCRATES	11	(8)	0.837	(0.360)
116	ARCHOSARGUSP ROBATOCEPHALUS	11	(9)	18.780	(16.660)
117	DROMIDIA ANTILLENSIS	11	(0)	0.428	(0.000)
118	BREVOORTIA SMITHI	10	(10)	2.370	(2.370)
119	RISSOLA MARGINATA	10	(10)	0.391	(0.391)
120	ALECTIS CILIARIUS	10	(10)	0.369	(0.369)
121	OCTOPUS VULGARIS	10	(4)	1.080	(0.413)
122	RACHYCENTRON CANADUM	9	(8)	5.376	(5.128)

RANK	SPECIES	TOTAL NUMBER		TOTAL WEIGHT	
123	HIPPOCAMPUS ERECTUS	8	(5)	0.091	(0.056)
124	CANCER IRRORATUS	8	(7)	0.055	(0.052)
125	PETROLISTHES ARMATUS	8	(8)	0.017	(0.017)
126	SCORPAENA CALCARATA	7	(1)	0.117	(0.036)
127	PARALICHTHYS SQUAMILENTUS	7	(7)	0.389	(0.389)
128	ALUTERUS SCHOEPFI	7	(4)	2.938	(0.389)
129	UPENEUS PARVUS	7	(4)	0.067	(0.014)
130	LYSMATA WURDEMANNI	7	(7)	0.447	(0.447)
131	CARCHARHINUS ACRONOTUS	6	(6)	47.048	(47.048)
132	AETOBATUS NARINARI	6	(6)	21.190	(21.190)
133	TRACHINOCEPHALUS MYOPS	6	(0)	0.205	(0.000)
134	MUGIL CUREMA	6	(6)	0.140	(0.140)
135	LUTJANUS SYNAGRIS	6	(6)	0.132	(0.132)
136	DASYATIS CENTROURA	5	(5)	165.644	(165.644)
137	OGCOCEPHALUS CUBIFRONS	5	(0)	1.088	(0.000)
138	OPSANUS TAU	5	(5)	1.087	(1.087)
139	OLIGOPLITES SAURUS	5	(5)	0.058	(0.058)
140	CYNOSCION NEBULOSUS	5	(5)	0.867	(0.867)
141	PRIONOTUS OPHRYAS	5	(1)	0.056	(0.013)
142	OGCOCEPHALUS ROSTELLUM	4	(4)	0.333	(0.333)
143	SERIOLA ZONATA	4	(4)	0.313	(0.313)
144	HYPLEUROCHILUS GEMINATUS	4	(4)	0.007	(0.007)
145	ALOPIAS VULPINUS	4	(4)	128.300	(128.300)
146	PAGURUS IMPRESSUS	4	(0)	0.236	(0.000)
147	CARCHARHINUS PLUMBEUS	3	(3)	57.770	(57.770)
148	MEMBRAS MARTINICA	3	(3)	0.015	(0.015)
149	SYNGNATHUS LOUISIANAE	3	(3)	0.053	(0.053)
150	LUTJANUS CAMPECHANUS	3	(2)	0.068	(0.056)
151	ASTROSCOPUS Y-GRAECUM	3	(3)	0.021	(0.021)
152	SCOMBER JAPONICUS	3	(3)	0.015	(0.015)
153	SPHYRNA LEWINI	2	(2)	1.103	(1.103)
154	OGCOCEPHALUS PARVUS	2	(1)	0.367	(0.008)
155	SYNGNATHUS FUSCUS	2	(2)	0.020	(0.020)
156	SERRANUS SUBLIGARIUS	2	(0)	0.020	(0.000)
157	SCIAENOPS OCELLATA	2	(2)	23.020	(23.020)
158	CARCHARHINUS BREVIPINNA	2	(2)	6.720	(6.720)
159	SICYONIA LAEVIGATA	2	(0)	0.013	(0.000)
160	SYNALPHEUS FRITZMUELLERI	2	(2)	0.005	(0.005)
161	PETROCHIRUS DIOGENES	2	(1)	0.386	(0.014)
162	HYPOCONCHA ARCUATA	2	(2)	0.015	(0.015)
163	EUGOMPHODUS TAURUS	1	(1)	16.540	(16.540)
164	CARCHARHINUS ISODON	1	(1)	2.000	(2.000)

RANK	SPECIES	TOTAL NUMBER		TOTAL WEIGHT	
165	SQUATINA DUMERIL	1	(1)	12.600	(12.600)
166	NARCINE BRASILIENSIS	1	(1)	0.750	(0.750)
167	ELOPS SAURUS	1	(1)	0.130	(0.130)
168	CONGER OCEANICUS	1	(1)	0.230	(0.230)
169	UROPHYCIS EARLLI	1	(1)	0.200	(0.200)
170	ABLENNES HIANS	1	(1)	0.014	(0.014)
171	MENIDIA BERYLLINA	1	(1)	0.005	(0.005)
172	MENIDIA MENIDIA	1	(1)	0.003	(0.003)
173	PRIACANTHUS ARENATUS	1	(0)	0.013	(0.000)
174	CARANX BARTHOLOMAEI	1	(1)	0.006	(0.006)
175	SELAR CRUMENOPHTHALMUS	1	(0)	0.060	(0.000)
176	SERIOLA DUMERILI	1	(1)	0.087	(0.087)
177	TRACHURUS LATHAMI	1	(0)	0.035	(0.000)
178	CALAMUS LEUCOSTEUS	1	(1)	0.860	(0.860)
179	DIPLODUS HOLBROOKI	1	(1)	0.011	(0.011)
180	MUGIL CEPHALUS	1	(1)	0.015	(0.015)
181	HYPSOBLENNIUS HENTZI	1	(1)	0.015	(0.015)
182	GOBIOSOMA BOSCI	1	(1)	0.008	(0.008)
183	GYMNACHIRUS MELAS	1	(1)	0.020	(0.020)
184	LABRISOMUS NUCHIPINNIS	1	(1)	0.039	(0.039)
185	STRONGYLURA NOTATA	1	(1)	0.053	(0.053)
186	HYPORHAMPUS MEEKI	1	(1)	0.006	(0.006)
187	ALPHEUS HETEROCHAELIS	1	(1)	0.003	(0.003)
188	EXHIPPOLYSMATA OPLOPHOROIDES	1	(1)	0.002	(0.002)
189	PORCELLANA SIGSBEIANA	1	(1)	0.001	(0.001)
190	PODOCHELA RIISEI	1	(0)	0.002	(0.000)
191	PELIA MUTICA	1	(1)	0.001	(0.001)

Appendix 4. Summary of effort (number of trawl tows), diversity (number of species), abundance (number of individuals), biomass (kg), density of individuals (number/ha), and density of biomass (kg/ha), excluding miscellaneous invertebrates and algae, by region and season from inner strata in 1999.

					DENSITY	
	TOWS	**SPECIES**	**INDIVIDUALS**	**BIOMASS**	**INDIVIDUALS**	**BIOMASS**
REGION						
RALEIGH BAY	12	86	46296	2875.2	1057.6	65.7
ONSLOW BAY	30	116	45132	2755.3	399.9	24.4
LONG BAY	48	133	54323	2975.7	299.6	16.4
S. CAROLINA	66	127	73092	2772.0	293.9	11.1
GEORGIA	48	115	47420	1172.5	266.7	6.6
FLORIDA	30	111	29743	1376.2	267.0	12.4
SEASON						
SPRING	78	128	78325	5319.8	267.0	18.1
SUMMER	78	118	60457	3001.3	210.3	10.4
FALL	78	146	157224	5605.9	532.8	19.0

Appendix 5. Regional and seasonal estimates of density of abundance (individuals/ha) and biomass (kg/ha), excluding miscellaneous invertebrates and algae, for dominant species from inner strata in 1999.

	INNER	REGION						SEASON		
	STRATA	RB	OB	LB	SC	GA	FL	SPR	SUM	FAL
ABUNDANCE										
Micropogonias undulatus	59.1	597.7	75.2	61.8	15.2	2.2	15.4	55.9	37.6	83.1
Litopenaeus setiferus	34.8	36.0	18.1	37.0	51.8	35.5	8.5	13.6	2.1	87.7
Chloroscombrus chrysurus	21.9	0.02	0.5	3.1	8.2	46.0	75.2	33.3	19.6	12.9
Leiostomus xanthurus	21.2	19.1	57.5	27.3	7.9	2.7	34.2	22.1	29.8	11.8
Anchoa hepsetus	16.9	79.4	18.9	19.9	9.5	8.4	15.2	25.2	8.3	17.0
Lagodon rhomboides	15.9	20.0	88.4	15.7	0.5	0.2	0.5	3.6	13.1	30.7
BIOMASS										
Micropogonias undulatus	3.0	28.8	4.4	3.2	0.7	0.1	0.6	2.0	2.2	4.6
Leiostomus xanthurus	1.0	0.8	2.5	1.3	0.4	0.1	1.8	1.1	1.3	0.6
Rhinoptera bonasus	0.9	1.5	0.8	1.0	1.4	0.4	0.7	1.8	0.08	0.9
Menticirrhus americanus	0.8	5.7	0.8	0.4	0.7	0.5	0.7	0.8	0.4	1.3
Litopenaeus setiferus	0.8	1.2	0.4	0.8	1.2	0.9	0.2	0.4	0.08	2.0
Lagodon rhomboides	0.7	0.6	4.4	0.6	0.01	0.006	0.01	0.07	0.6	1.5

Appendix 6. Summary of incidental catch data of sea turtles in 1999.

Collection Number	Date	Species	First Tag	Second Tag	Curved Length	Curved Width	Straight Length	Straight Width	Sex	Weigh t	Latitude	Longitude	Strata	Region
						Spring 1999								
990037	04/15/1999	Caretta caretta	SSR901	SSR902	63.0	61.0	56.5	50.0	U	28.37	32°50.08	79°39.67	47M2	SC
990037	04/15/1999	Caretta caretta	SSR903	SSR904	72.0	71.0	66.0	55.5	U	57.00	32°50.08	79°39.67	47M2	SC
990088	04/26/1999	Lepidochelys kempi	SSR905	SSR906	37.5	39.0	35.5	33.0	U	7.29	32°34.31	80°01.65	43M6	SC
990112	04/28/1999	Caretta caretta	SSR907	SSR908	64.0	59.0	59.0	49.0	U	31.41	29°21.52	81°03.81	25M3	FL
990114	04/28/1999	Caretta caretta	SSR910	SSR911	64.0	63.0	59.0	50.0	U	34.51	29°15.88	80°58.55	26M2	FL
990125	04/29/1999	Caretta caretta	SSR913	SSR914	71.0	67.0	66.0	53.5	U	45.20	29°34.57	81°07.71	28M3	FL
990126	04/29/1999	Caretta caretta	SSR909	SSR912	74.0	71.0	70.0	56.0	U	60.00	29°34.57	81°07.71	28M3	FL
990157	05/06/1999	Lepidochelys kempi	SSR915	SSR916	48.0	53.0	46.0	48.0	U	14.80	30°20.18	81°23.18	29M1	FL
990161	05/06/1999	Caretta caretta	SSR919	SSR920	58.0	56.0	55.0	45.0	U	21.26	30°34.71	81°22.70	32M5	GA
990162	05/06/1999	Caretta caretta	SSR917	SSR918	60.0	59.0	56.0	47.0	U	29.86	30°34.71	81°22.70	32M5	GA
990190	05/12/1999	Lepidochelys kempi	SSR921	SSR922	51.5	54.5	49.0	49.0	U	18.20	31°10.88	81°15.85	35M5	GA
990199	05/12/1999	Caretta caretta	SSR923	SSR924	72.0	68.0	67.0	54.5	U	43.57	31°26.41	81°06.02	37M3	GA
						Summer 1999								
990216	07/12/1999	Caretta caretta	SSR925	SSR926	69.0	66.0	65.0	52.5	U	34.24	32°29.69	80°10.96	43M2	SC
990323	07/28/1999	Caretta caretta	SSR927	SSR928	67.0	66.0	62.5	53.0	U	40.75	33°19.14	79°07.85	51M5	LB
990332	07/28/1999	Caretta caretta	SSR929	SSR930	94.0	86.0	88.0	69.5	M	100.00	33°49.24	79°03.45	51M0	LB
990340	07/29/1999	Lepidochelys kempi	SSR931	SSR932	54.0	60.0	51.0	53.0	U	21.32	33°53.92	78°12.91	55M4	LB
990364	07/30/1999	Caretta caretta	SSR933	SSR934	67.0	64.0	63.0	53.5	U	37.92	32°56.90	79°23.73	49M6	SC
						Fall 1999								
990398	10/07/1999	Caretta caretta	SSR935	SSR936	71.0	69.0	66.0	57.0	U	45.20	33°36.69	78°56.36	51M8	LB
990462	10/21/1999	Caretta caretta	SSR937	SSR938	64.0	60.0	60.0	50.0	U	30.72	29°46.43	81°14.71	27M2	FL
990481	10/26/1999	Caretta caretta	SSR939	SSR940	65.0	65.0	59.5	50.0	U	37.94	31°08.38	81°15.23	35M4	GA
990486	10/26/1999	Lepidochelys kempi	SSR941	SSR942	35.0	36.0	33.0	31.0	U	5.52	31°23.26	81°09.99	35M1	GA
990493	10/26/1999	Caretta caretta	SSR943	SSR944	66.0	61.0	61.5	49.0	U	34.95	31°43.66	81°02.40	37M6	GA
990494	10/26/1999	Caretta caretta	SSR945	SSR946	70.0	67.0	65.0	52.0	U	47.62	31°43.66	81°02.40	37M6	GA
990532	11/06/1999	Caretta caretta	SSR947	SSR948	69.0	66.0	65.0	53.0	U	40.03	34°38.90	76°34.36	63M2	OB
990540	11/07/1999	Caretta caretta	SSR949	SSR950	73.0	70.0	68.0	55.0	U	45.34	33°29.46	79°03.37°	51M0	LB